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'Mine not to reason why'

Armed Forces of the World: Spain

ASROC: Fleet Defender

A fully illustrated guide to Modern Underwater Weapon Systems

WAR MACHINE

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Managing Editor: Stan Morse
Editorial: Trisha Palmer
Chris Bishop
Chris Chant
Ian Drury

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Subscription Manager: Christine Allen
0488 72666

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:
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Orbis House
20-22 Bedfordbury
London WC2N 4BT
Telephone: 01-379 6711

Circulation Manager: Brian Anderson
Marketing Manager: Paul Stelb

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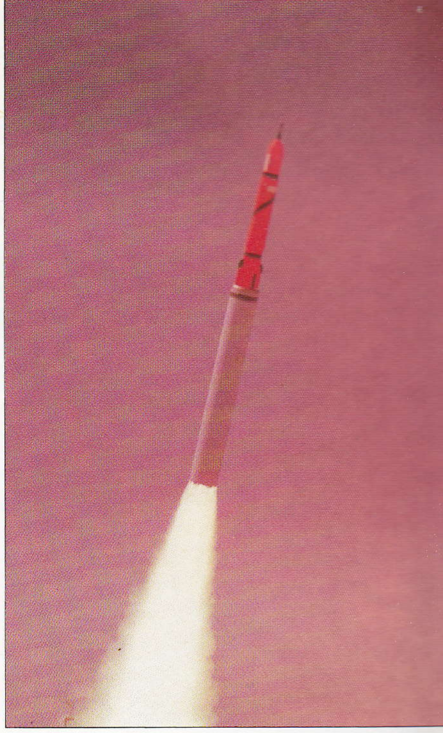
Modern Underwater Weapon Systems



One of the more novel types of ASW weapon fielded to date has been the submarine-launched missile. SUBROC, launched from the torpedo tubes of attack submarines, carries a one-kiloton nuclear depth bomb as payload, which has a lethal radius of 5 to 8 km (3 to 5 miles).

The battle of the Atlantic in World War II led to enormous advances in underwater weapon systems and their associated sensors; since then both submarines and surface vessels have acquired increasingly complex rocket and missile systems with substantially longer ranges.

There are two major types of anti-submarine projectiles, the proximity and the contact weapon. The former, typified by the depth charge which the Royal Navy first used in combat in 1916 during World War I, must carry an explosive charge large enough to damage a submerged target even at a considerable miss distance. The greatest lethal radius of weapons of this type is achieved by the nuclear depth charge, against which there is little defence, and which can destroy or severely damage targets within several thousand metres of its point of detonation. However, only the two great superpowers, the USA and USSR, actually have such weapons in large numbers, while their allied nations have them to a much lesser extent.

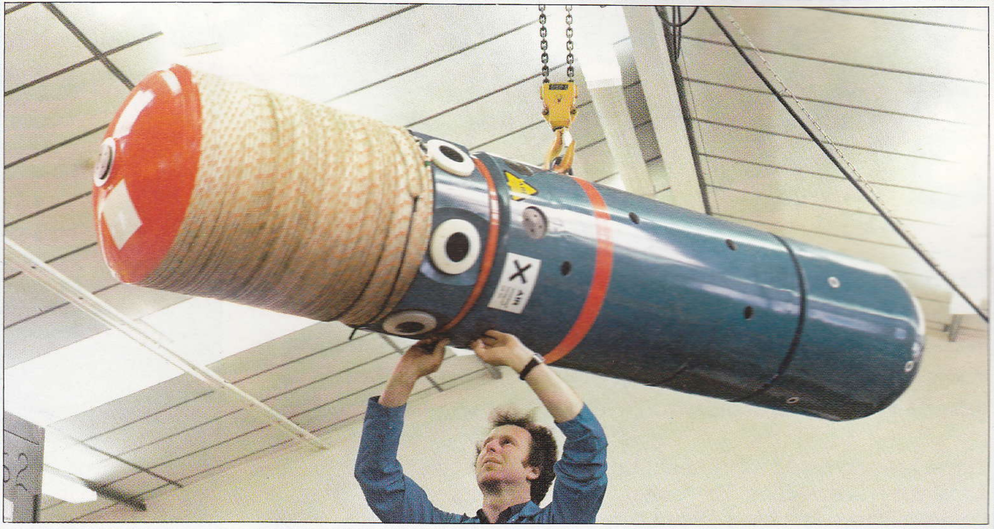
The second projectile type generally relies on much smaller warhead sizes, but must either be specifically guided onto its target or be used in such numbers that a hit is virtually guaranteed. The classic example of such a weapon is the World War II Hedgehog system. The intermediate case between the two is the lightweight ASW (anti-submarine warfare) homing torpedo, which with its great homing radius effectively covers the lethal distance of a nuclear weapon but needs close proximity or actual contact with the target to detonate. To bring such a weapon into the vicinity of a distant target very often requires a carrier platform which may be guided or unguided. Examples of these are respectively the Australian Ikara missile and the Soviet FRAS-1.

For the future, as sensor ranges increase guided weapons will be developed with advanced-technology homing torpedo or nuclear payloads and ranges in excess of 50 km (31.1 miles). The first of these, the ASW-SOW, is already in the final design stages for deployment in the late 1980s to replace the elderly UUM-44A SUBROC missile aboard American SSNs.

The main development in ASW techniques in recent years has seen the use of a guided missile to carry a torpedo or depth bomb to within striking distance of a target. The Australian-developed Ikara system, with its lightweight torpedo payload, is typical of the types in use today.

'Mine not to reason why'

Modern mine technology has evolved immensely in the last few decades, a product of the computer and electronic revolution that has so changed the face of warfare. Today's mine bears little resemblance to the horned monsters so feared by sailors in bygone wars but its purpose remains the same – to deny an enemy free use of the seas and to sink his ships if possible. It also has the advantage of being relatively cheap.



The British Versatile Mine system displays many of the characteristics of modern mine technology. Its small size means it can be laid by a submarine through its torpedo tubes, often in a location to do most damage to opposing submarines.

As is generally understood, Soviet access to the high seas is restricted by the existence of various 'choke' points, (or heavily defended narrow channels) flanked or controlled by NATO-friendly countries. The entrance to the Baltic is a case in point: controlled by Denmark, Norway and Sweden, the Skagerrak poses a real problem to Soviet naval commanders. And, beyond that, access to the North Atlantic is controlled by the UK. Similar problems for the Soviets exist in the Mediterranean and the Pacific; and in these areas mine warfare really comes into its own.

Irrespective of warhead, mines come in four types or, more correctly, mine detonation systems come in four types, though certain mines can have one, two or even three detonating systems, as we shall see. Acoustic mines are actuated by noise (a combination of water drops falling off a passing hull or, in the case of submarines, water passing through and over the outer casing), propeller noise, and engine and life-support machinery noises. This noise is picked up by the mine's hydrophones, which gradually become covered with mud and sea growth and so are designed to increase their sensitivity with time. Eventually, however, all sensitivity goes and/or their batteries run down. Acoustic mines can be made to respond only to specific ship or submarine noise 'signatures'. As a result, it is not possible to sweep an acoustic minefield simply by generating noise on a towed array: every mine must be individually found and destroyed.

Selective explosions

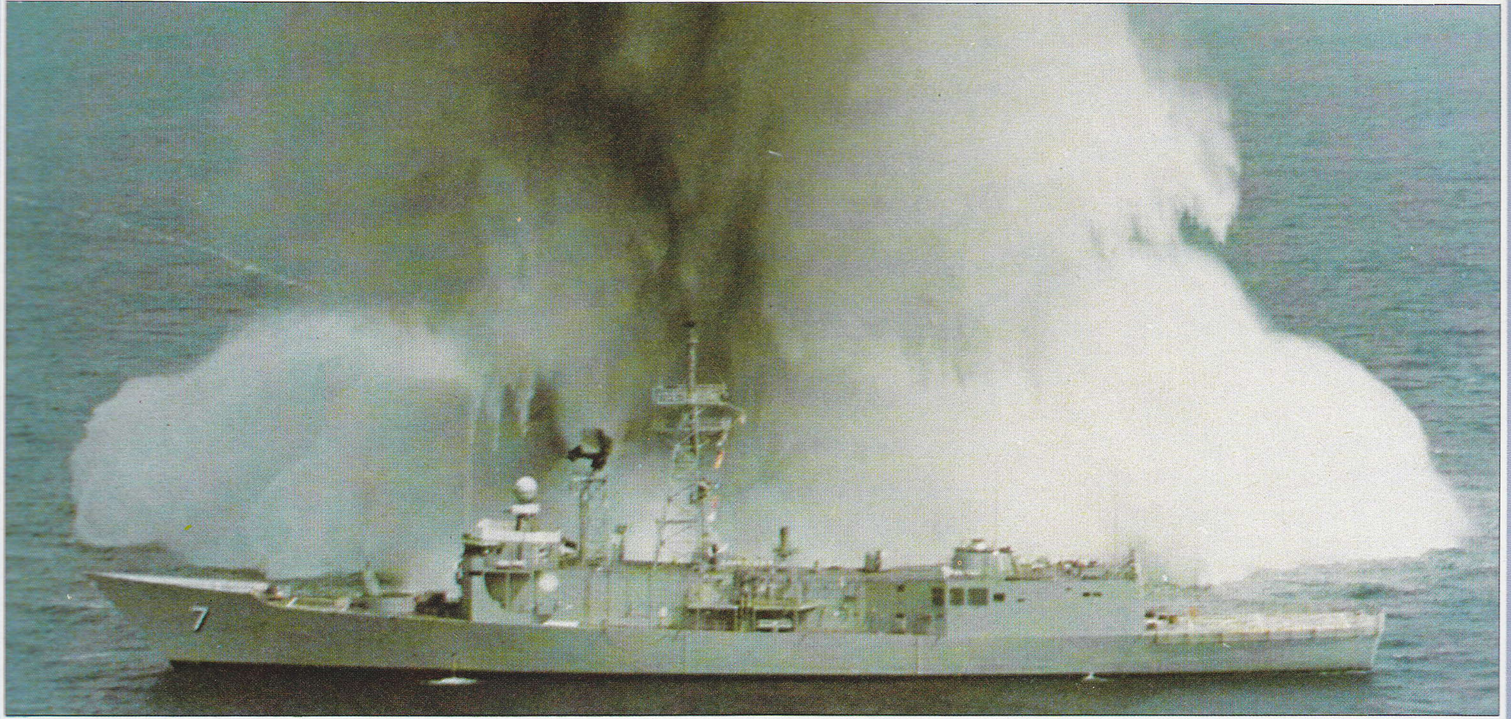
Magnetic mines are activated by a change in the Earth's magnetic field caused by the proximity of a large metal conductor nearby, e.g. an unlucky ship. They can be programmed to explode when different sized ships pass overhead. In this way they can ignore accompanying frigates, destroyers etc. and take out an aircraft-carrier. Again, they have to be individually located and destroyed, although a towed array can have some success in exploding them.

Pressure mines are actuated by changes in water pressure caused by the passage of a medium- to large-sized ship or submarine. If they were set to be sensitive to anything smaller, the whale population would taken an even greater turn for the worse. And again, although various sweeping techniques have been developed, it would seem that these mines, too, must be individually located and destroyed.

The final type of mine is the contact mine, beloved of World War II movie makers. Whereas the previous three types are anchored on or close to the bottom, contact mines lurk just below the surface.

Acoustic, magnetic and pressure mines are far more effective than contact mines inasmuch as a blast close to the sea bed goes only in one direction (upwards) and thus does more dam-

The partially-completed USS Oliver Hazard Perry undergoes the structural tests essential in making any new design of warship resistant to damage, especially from mines.



age than a contact mine, whose blast is dissipated spherically. The disadvantages of the acoustic, magnetic and pressure mines are that they have to be laid in shallow water and are subject to nervous breakdowns. Think about it for a moment. The electronics used to actuate an acoustic, magnetic or pressure mine are fairly complicated. In those instances where a mine can be actuated by a combination of all three, or in the case of a mine that has been programmed to 'count' (i.e. ignore the first, second, third or whatever contact) so that escort vessels will again escape unharmed, the electronics have to be both complex and sensitive. Now the sea itself is not a neutral, static medium. Changes in water pressure occur with changes in water temperature and salinity. Background noise can be increased by something as mundane as a passing school of dolphins. The Earth's magnetic field is in a state of flux. In other words, as time goes on and the mine gets tired (batteries run down), it is faced with making more and more decisions, assimilating more and more data in order to function properly. Either it sulks, and refuses to explode at all, or allows itself to be triggered by the smallest stimulus.

High cost

Even though the average mine costs only between £3,000 and £6,000, minelaying can obviously be an expensive business. Moreover, there are a few other ships in the sea besides Soviet warships, and amongst others the ferry operators would not take it kindly if one of their vessels were blown out of the North Sea.

As a result, mines are only sown at the last moment; and with this, a new type of mine actuation has been developed: remote control.

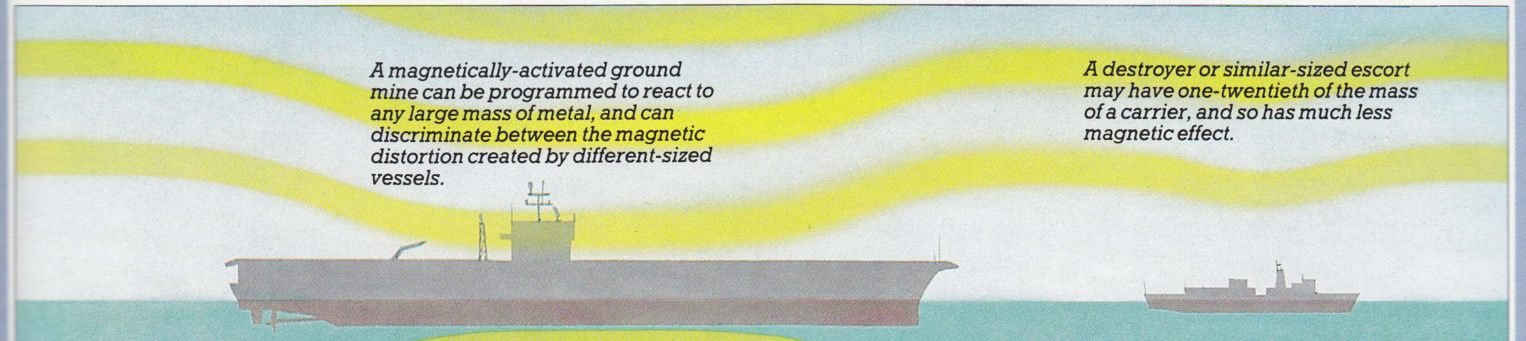
Under the Geneva Convention (which everyone quotes when the other party contravenes it), all minefields must be charted, which rather does away with the element of surprise. In fact, there is very little reason to sow minefields far in advance because it is a comparatively easy task that can be undertaken by aircraft, helicopter, surface ship or submarine.

Usually aircraft are preferred, particularly when the mines are to be laid close into one's own shoreline. However, there is one type of mine that is (or rather, will be) sown by submarine: the type of mine that lurks outside a harbour belonging to 'the other side'. It has to be launched by submarine because obviously the other side is not going to be thrilled by the prospect of enemy aircraft overflying their airspace and dropping mines where they can blow the latest nuclear submarine to thousands of radioactive bits. It works this way. A hunter/killer submarine (probably diesel-electric as it runs more quietly than a nuclear boat, and is thus less likely to be detected, and also less expensive if destroyed) slips past the (say) Soviet defences and reaches a point about 30 km (18.6 miles) from Thekola Peninsula. It then launches a torpedo weighing 1069 kg (2,356 lb) and measuring 533 mm (21 in) in diameter by 3.506 m (11 ft 6 in) in length. The submarine has in fact just launched the US Mk 67 mobile mine, which is a variable-influence mine converted from a Mk 37 torpedo. As we have seen, that mine can be set to respond to acoustic, magnetic or pressure detection of a possible target, and can also be set to ignore everything except the one ship or submarine that has been targeted (unless another ship or submarine leaves port with identical acoustic signatures, which is unlikely). When and if the mine (and by now it has sunk to the sea bed) detects its target a rocket fires to propel the mine upwards to a point at which it can make satisfactory contact with the target's bottom. At this point it explodes and, especially if it is a nuclear mine, causes devastating damage. However, it is more likely to be a CAPTOR type mine with a 43.5-kg (96-lb) warhead (of which more later). The only point at question here is, assuming it does make contact with one of the giant Soviet double-hulled submarines, how much damage would it do? Well, unless there was a great deal of luck (or bad luck, depending on your sympathies) involved, the submarine would be unlikely to sink. But it would be damaged sufficiently to prevent it carrying out its mission, which would be to get as far away from Murmansk as possible before firing its nuclear missiles.

Standard conversion

It should not be thought that all mines are purpose-built for the job. It is often only the triggering device that is specifically designed to work underwater and to respond to 'naval' stimuli. Virtually any type of standard bomb can be converted to the mine role with the limitations that it can be deployed only in shallow waters and that the casing will in time start to leak. One of the recent, classic, examples of this has been the US DESTRUCTOR mine, which was developed as a direct result of the Vietnam War. It is essentially a Mk 64 907-kg (2,000-lb) bomb, with magnetic and acoustic sensors added to the fuse pocket. Deployed by parachute, it is equally effective by land and sea, meaning that it can be plastered over a major port, always assuming that the launch aircraft do not get shot down in the process. It was developed largely because the Americans had so many bombs surplus to requirements during the Vietnam War (there is a limit to how many times you can blow up the same tree) and DESTRUCTOR figured quite heavily in the mining of Haiphong harbour. It is also very cost effective as one need employ only the single assembly line for naval, military and economic targets. However, it is not the most sophisticated mine in the world and should (in fact could) only be used against militarily unsophisticated countries.

The Earth has a large magnetic field, the force lines of which lie parallel to the Earth's surface in most locations. Like all magnetic fields, the passage of metal through the field will produce distortions in the lines of force, and it is these distortions that magnetic mines detect.



A magnetically-activated ground mine can be programmed to react to any large mass of metal, and can discriminate between the magnetic distortion created by different-sized vessels.

A destroyer or similar-sized escort may have one-twentieth of the mass of a carrier, and so has much less magnetic effect.

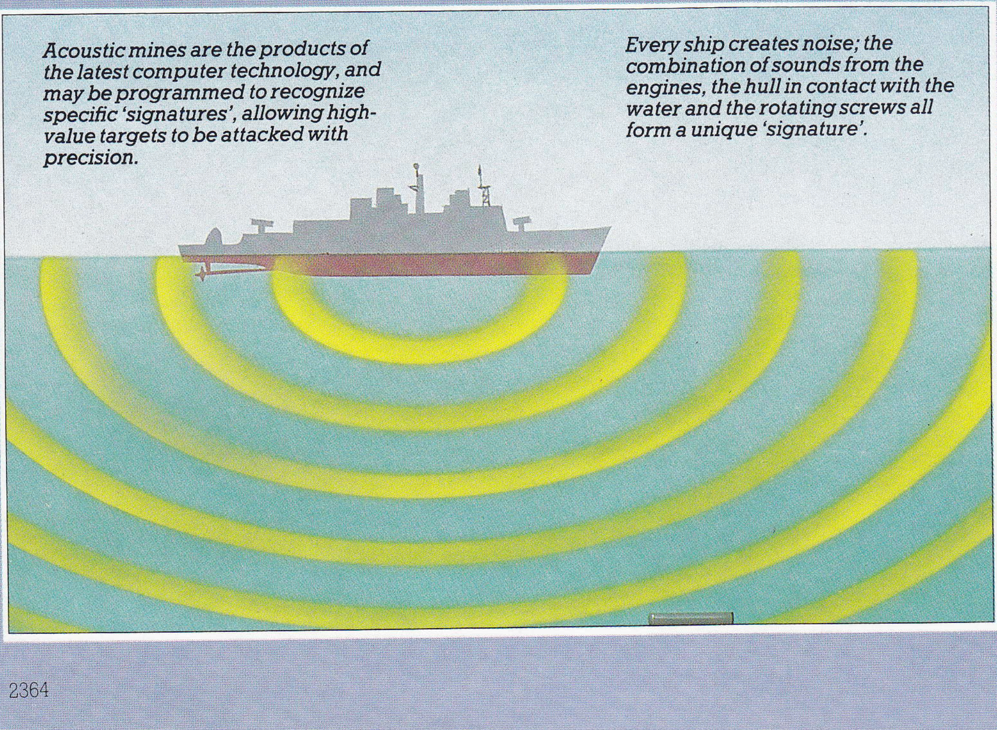
An aircraft carrier may be many things, but it is most certainly an extremely large piece of metal. The distortion it produces in the Earth's field is correspondingly large.

'Mine not to reason why'

Now it is worth taking a look at mine warfare's 'state of the art'. The various 'choke' points that restrict Soviet access to the world's oceans are, in the first instance, guarded by a system of passive listening devices called SOSUS (SOund SUrveillance System). These are hydrophones (anchored to the sea bottom) that can release their data in short-burst transmissions. Often they are backed up by cables coiled in the same area to monitor the change in the Earth's magnetic field caused by a passing ship. However, these are only passive sensor devices, and this causes a problem. SOSUS is capable of detecting a submarine at a distance of some 160 km (99.4 miles). However, sound in water travels at only 1450 m (4,757 ft) per second, so the sound from a submarine detected at a maximum range will take 110 seconds to reach SOSUS. If the submarine is travelling at 25 kts (46.3 km/h), the vessel will have moved another 1.42 km (0.88 miles) by the time its sound waves reach the SOSUS hydrophones. But although it is always nice to know where something was a few minutes ago, it does not help very much if you are trying to destroy it. For that, you have to know where it will be located in a few minutes from now. Enter JEZEBEL, a far-from-passive listening device. JEZEBEL will, when alerted, send out its own sonar signals in an attempt to discover the submarine's course and speed. Assuming that it is successful, JEZEBEL will then release CAPTOR in its guise as a homing torpedo. Given that the US Mk 46 torpedo has an 11-km (6.84-mile) range and that CAPTOR need not be situated close to JEZEBEL, but connected via underwater cable, you have a pretty formidable underwater detection and attack system. CAPTOR is essentially a mine. And although CAPTOR is not adverse to being delivered directly to the target by torpedo, that method does have one built-in disadvantage: a submarine can pick up an approaching torpedo on its own detection equipment and either take evasive action or attempt to destroy it by firing its own anti-torpedo torpedoes. It is far better that the submarine should pass over, or close to, the spot where CAPTOR has been silently waiting for it, so that when a panic-stricken sonar operator realizes something is rising rapidly towards his submarine from the sea bottom at some 40 kts it is too late to do anything about it.

The reduced size and hence air-portability of modern mines has given military planners many options when considering laying techniques. The B-52s of the USAF Strategic Air Command allow worldwide mining operations at very short notice.

Acoustic mines, as the name suggests, are triggered by the noise created by passing ships or submarines. They may have their own listening gear, or they may be controlled remotely by underwater sonar arrays, such as the SOSUS line in the GIUK gap.



Acoustic mines are the products of the latest computer technology, and may be programmed to recognize specific 'signatures', allowing high-value targets to be attacked with precision.

Every ship creates noise; the combination of sounds from the engines, the hull in contact with the water and the rotating screws all form a unique 'signature'.

However, there is again the same obvious problem with the SOSUS/JEZEBEL/CAPTOR system, namely deployment. While SOSUS or JEZEBEL cannot in themselves harm anyone, they can be corroded by sea water and fouled by marine life. So while initial deployment is comparatively cheap, the maintenance and replacement necessary for an efficient system becomes fairly expensive. CAPTOR is another problem altogether. It is not, as yet, against the law for Soviet submarines to pass through 'choke' points into the ocean. And if the ferry companies are likely to be upset about one of their ferries being blown out of the North Sea, one can imagine what the Soviets would say about the same happening to one of their submarines.

What this means is that CAPTOR should only be deployed on the high seas in those very few days before hostilities are openly declared.

CAPTOR is part of the PRAM (Propelled Rapid Ascent Mine) family, although purists would argue that since CAPTOR is delivered on instructions from JEZEBEL it is more torpedo than mine. Another difference is that PRAMs are, by and large, set to operate independently and control only a small section of sea.

Threat to friendly craft

One of the major problems that mines pose to their owners is the threat they constitute to friendly forces. The things to remember are that after a time a mine is as likely to attack friendly ships and submarines as enemy vessels, and that mines have this annoying habit of not always staying in the place they were originally dropped. Undoubtedly CAPTOR, PRAM and others have been fitted with identification devices and even self-destruct devices, but no one can guarantee that these will work: man knows more about the surface of the moon than about the sea bed, and many strange things happen down there.

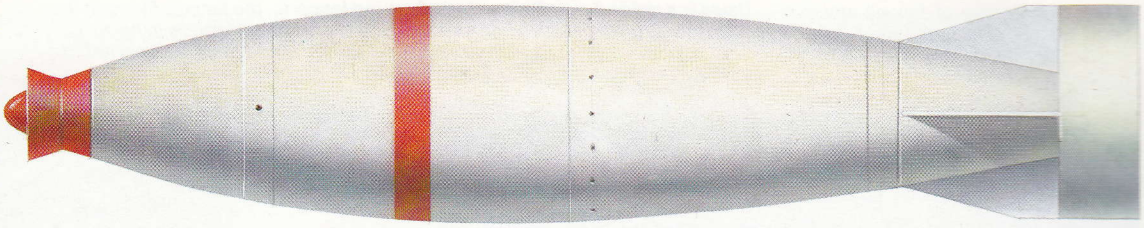
Nonetheless, mines still remain an extremely effective weapon, for one very good reason: it is difficult to locate them. In times of war, any ship or submarine commander must assume that there are mines out there waiting for him, and this gives him far less flexibility of operation than he would like. Mines may have come a long way from the time that they could be kicked away (carefully avoiding the horns) by whichever actor was playing the part of the hero in all those post-World War II movies, but the reality is that they are just as terrifying a prospect to sailors of whatever navy now as they were 40-odd years ago. They may have got smarter, but they are still robots and one cannot bluff (or even surrender to) a robot.

SWEDEN

Bofors 375-mm ASW rocket-launcher systems

The initial four-tube **Bofors 375-mm** (14.76-in) ASW rocket-launcher system was developed in the early 1950s, and became operational on Swedish navy destroyers in 1955-6. The ship's sonar provides target data for calculating the launcher elevation and bearing for firing. Single or multi-round salvoes can be fired, the ballistic shape of the rockets ensuring a predictable and accurate underwater trajectory. Once empty the launcher is automatically reloaded in three minutes from the magazine located directly beneath it. Three types of rocket can be used, these differing in the types of motor and fuse in order to give different operational characteristics. The four-tube launcher is no longer in production, but is still used by the navies of Colombia, Japan, Portugal, Sweden, Peru, Turkey and West Germany. France uses a six-tube variant built under licence by Creusot-Loire.

During 1969-72 a twin-tube variant, the **SR375**, was developed. This is still in production, and is used by Brazil, Egypt, India, Indonesia, Malaysia, Morocco, Nigeria and Spain. The total number of rounds in the twin-tube launcher magazine is 24, while for the four-tube launcher it varies from 36 on most ships to a maximum of 49 on the two Peruvian destroyer classes bought from the Dutch navy. The Swedish navy used its sole remaining four-tube system on the destroyer *Halland* during the early 1980s when hunting suspected Soviet submarine intruders in coastal waters.

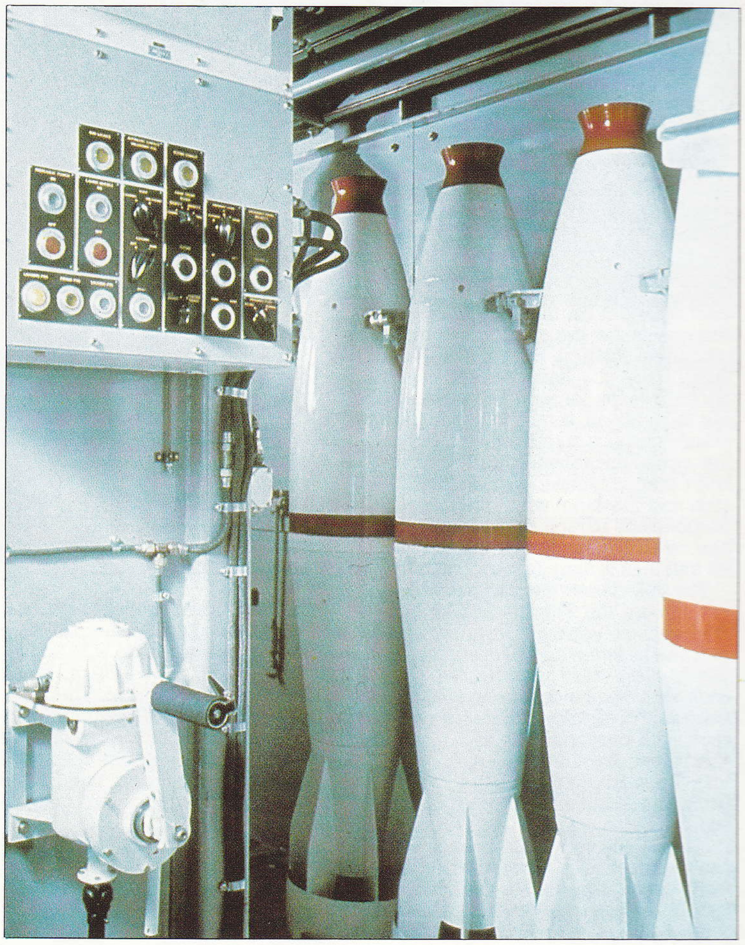


***Above:** The missiles fired from the Bofors 375-mm ASW launcher system have three different types of motor, giving a variety of ranges. Missile trajectory is flat to produce a short flight time, thus reducing the chances of successful evasive action by the target submarine.*

Specification

four-tube launcher
Calibre: 375 mm (14.76 in)
Weight: 7417 kg (16,352 lb)
Elevation: +15° to +90

two-tube launcher
Calibre: 375 mm (14.76 in)
Weight: 3861 kg (8,512 lb)
Elevation: 0° to +60°



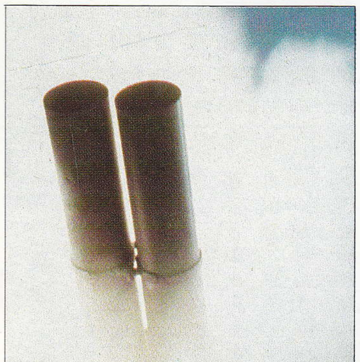
***Right:** The magazine of the four-tube launcher is located directly underneath, and once available rounds have been expended the launcher is automatically replenished from below.*

Rocket types:

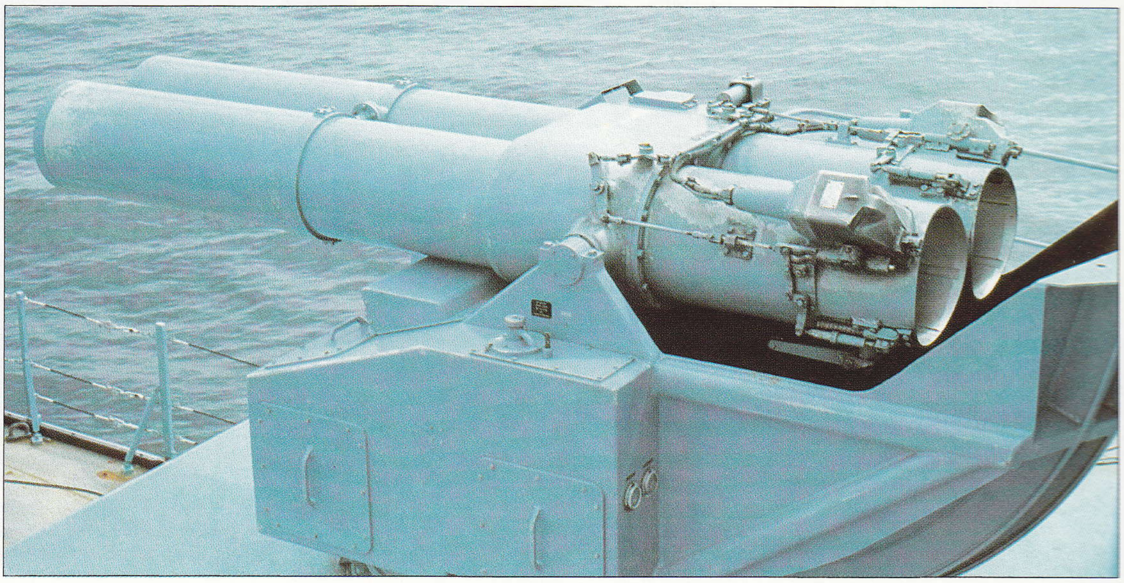
	weight	**length** (time fuse/ proximity fuse)	**HE charge**	**range**
M/50	250 kg (551 lb)	2/2.05 m (6.56/6.73 ft)	100 kg (220 lb)	355-850 m (1,165-2,790 ft)
Erika	250 kg (551 lb)	2/2.05 m (6.56/6.73 ft)	107 kg (236 lb)	655-1635 m (2,150-5,365 ft)
Nelli	250 kg (551 lb)	2/2.05 m (6.56/6.73 ft)	80 kg (176 lb)	1580-3625 m (5,185-11,895 ft)

Notes:
1 The M/50 and Erika can use the Stidar time and impact fuse.
2 All three can use the Zambo proximity and impact fuse with an influence radius of 15 m (49 ft).

***Below:** The twin launcher variant, designated SR375, was developed between 1969 and 1972 and is still in production today. It is fitted to the warships of eight navies including those of Spain and India.*

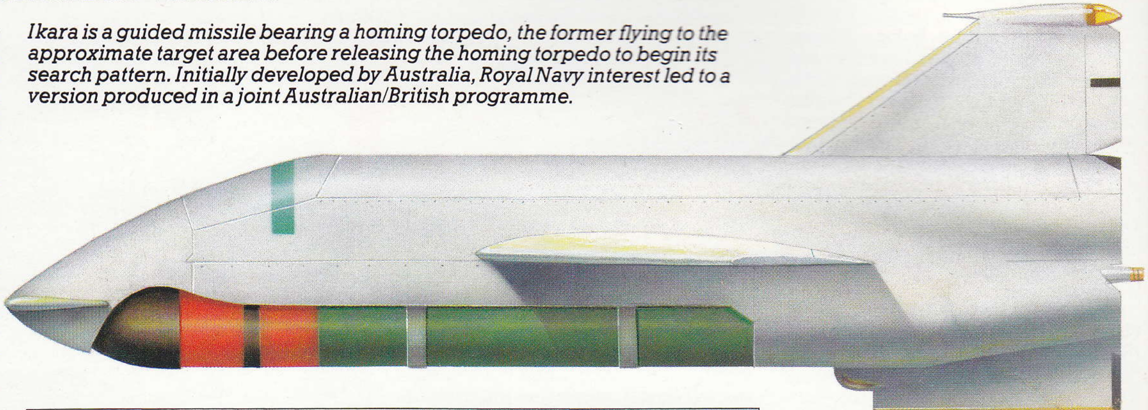


***Below:** The twin launcher can fire its missiles either separately or simultaneously, and the ballistic characteristics of the missile ensure the maintenance of an accurate trajectory once underwater.*



AUSTRALIA

Ikara anti-submarine missile

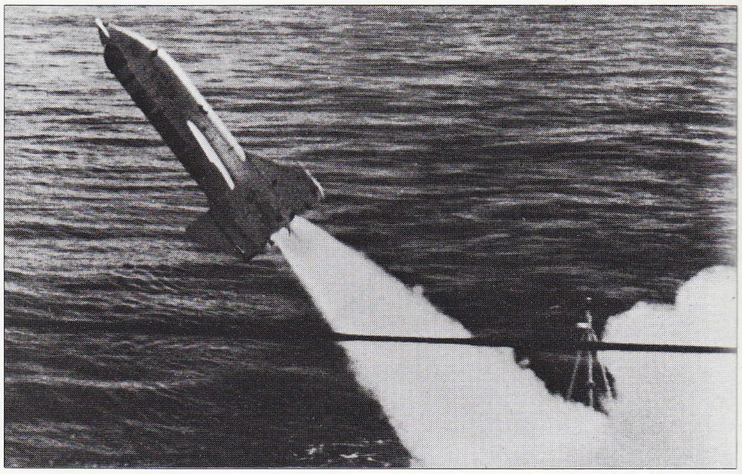


Ikara is a guided missile bearing a homing torpedo, the former flying to the approximate target area before releasing the homing torpedo to begin its search pattern. Initially developed by Australia, Royal Navy interest led to a version produced in a joint Australian/British programme.

The initial design of the all-weather **Ikara** missile was undertaken by the Australian government, but when the Royal Navy expressed an interest in the system the programme became a joint one with British Aerospace to produce the variant known as **GWS Mk 40**. A further version, the **Branik**, was developed to meet the needs of the Brazilian navy. This last differs from both the Australian and Royal Navy systems in employing a special-purpose missile tracking and guidance unit (fully integrated into one of the launch platform's two fire-control computers) and a new lightweight semi-automated missile-handling system.

The Ikara is powered by a solid-fuel combined booster and sustainer rocket, and in all forms is launched on a bearing to bring it to a torpedo payload-dropping position near to the target. Data for the latter's position is supplied either by the launch platform's own sonar or by a remote data-linked source such as another ship or helicopter. The information received is used for a continuous update of the optimum drop zone position on the ship's fire-control computer, which then passes it (in the form of control commands by the ship's radio/radar guidance system) to the missile in flight. Once the Ikara arrives at the target area the torpedo (a lightweight Mk 44 or Mk 46, semi-enclosed in the missile body) is command-ejected via the communications link. The Ikara body then continues on, clearing the area and crashing, while the torpedo descends by parachute to achieve the best orientation and entry into the water and then to start its search pattern.

Left: Once Ikara is launched, its flight path is controlled from the ship's computer, which calculates the optimum position for the release of the torpedo. Once it is dropped the torpedo discards its parachute on reaching the sea, and dives to seek out its target while the missile flies on out of the target area.



Below: Ikara is launched from the Brazilian navy's Mk 10 frigate BNS Defensora. *Brazilian Ikaras differ from the original system in employing a special-purpose missile-tracking and guiding unit, fully integrated into one of the two fire control computers.*

The ship classes fitted with the Ikara variants are the 'Niteroi' ASW frigate version of the Brazilian navy (four units with one launcher and 10 missiles); the 'Perth' class destroyers (three units each with two launchers and 24 missiles) and 'River' class frigates (six units each with one launcher and 24 missiles) of the Royal Australian Navy; the sole 'Type 82' destroyer HMS *Bristol* (with one launcher and 20 missiles) and the six remaining 'Leander Batch 1' class frigate conversions (each with one launcher and 14 missiles) of the Royal Navy; and the single 'Leander Batch 1' class conversion HMNZS *Southland* (ex-*Dido*) of the Royal New Zealand Navy. The Royal Navy has already put up for disposal another 'Leander Batch 1' unit, HMS *Ajax*, and is believed to be about to remove the Ikara system from its inventory for operational reasons.

In contrast the Australians have now teamed up with the Italians to produce a **Modified Ikakra** missile with folding fins, a box launcher and the guidance system of the Otomat SSM. The Modified Ikara can carry either of the two original torpedoes as its payload, or the Swedish Type 42 series, the Italian A244/S and AS290, and the British Stingray depending upon customer requirements.

Specification

Ikara

Dimensions: length 3.42 m (11.22 ft); wing span 1.52 m (4.99 ft); height 1.57 m (5.15 ft)

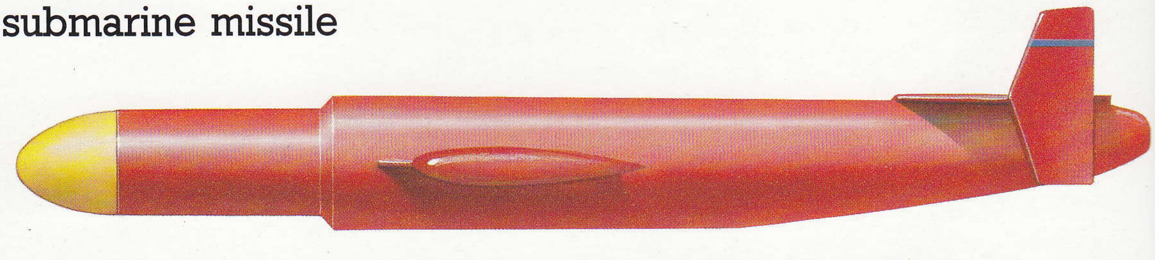
Weight: varies according to payload

Payload: lightweight ASW homing torpedo

Performance: maximum speed Mach 0.8; range 24 km (15 miles)

FRANCE

Malafon anti-submarine missile



Malafon is a shipborne homing acoustic torpedo delivered to the target area by a command-guided missile. Although primarily intended as an ASW weapon, it can be used to engage surface targets.

The Société Industrielle d'Aviation Latécoère **Malafon** surface-to-subsurface winged missile started development in 1956, and by 1959 a total of 21 test launches had been completed. The first sea launch and guidance test took place in 1962, with full systems evaluation of over 20 launches taking place in 1964. The final operational trials took place in the following year.

The Malafon is primarily an ASW weapon, but can also be used to attack surface targets if required. Detection and designation for subsurface targets is provided by the ship's sonars, while for surface targets it is by radar. The Malafon is ramp-launched, propulsion for the initial seconds of its flight being provided by two jettisonable solid-fuel boosters. Once these have been discarded the flight is unpowered, the gliding missile being stabilized by an automatic pilot and radio altimeter. In-flight control is effected via a command radio link, the missile being tracked with the aid of flares attached to the wingtips. On reaching the drop-zone area, at a distance of some 800 m (875 yards) from the estimated target position, a parachute is deployed to slow

Malafon is carried by 11 French vessels, in each case the fit consisting of a single launcher and 13 missiles. The DDG Duquesne *carries her Malafon launcher forward of the four MM.40 Exocet launchers and immediately abaft the funnel/mast.*

the Malafon. This causes the 533-mm (21-in) L4 acoustic-homing torpedo payload to be ejected into the water to complete the attack.

Fittings of the Malafon system on French navy ships have been made to the 'Tourville' class (three units), 'Suffren' class (two units), 'D'Estree' class (four units), the *Aconit* and the *La Galissonnière*. In each case the fit comprises one launcher and 13 missiles in a magazine.

Specification

Malafon

Dimensions: length 6.15 m (20.2 ft); wing span 3.3 m (10.8 ft); diameter 0.65 m (2.13 ft)

Weight: 1500 kg (3,307 lb)

Warhead: L4 acoustic-homing torpedo

Performance: maximum speed low subsonic; range 13 km (8.1 miles)

UK

Mk 10 Limbo anti-submarine mortar

Developed by the Admiralty Underwater Weapons Establishment during the 1950s, the **Mk 10 Limbo** mortar entered service with the Royal Navy in the early 1960s. Still used by that service, the Limbo is also in service with the navies of Australia, Canada, Indonesia, India, Iran, Malaysia and Thailand. Although considered obsolete, the Limbo is in fact a very potent weapon in shallow water where acoustic homing torpedoes are at a distinct disadvantage. The ship's own sonar provides the target position data to a predictor unit which computes the mortar barrel elevation information and lateral tilt. The three-barrel mortar is then set and fired to give a pattern of three bombs fused to give a three-dimensional explosive burst around the target. The bombs use either a preprogrammed pressure fuse or a delay-action time fuse with the settings made by remote control through relays and uniselectors. The maximum engagement depth is 375 m (1,230 ft). Far Eastern sources indicate that there is also a proximity influence fused bomb, which has virtually an unlimited maximum depth. The mortar is reloaded in the horizontal plane (by pneumatic rammers) from a ready-use magazine located alongside the weapon. The Royal Australian Navy's version is of an improved local type which is quieter in operation, uses modern electrical solid-state control systems and requires only three crew instead of the seven normally used.

Specification

Mk 10 Limbo

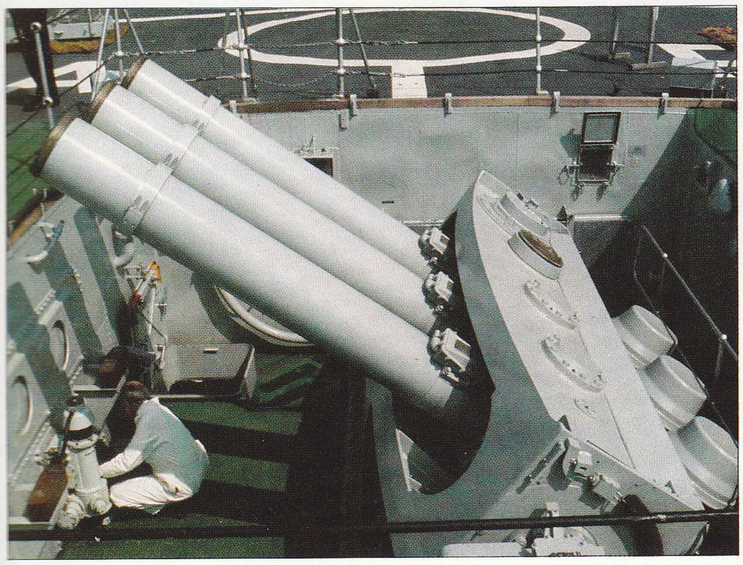
Calibre: 305 mm (12 in)

Number of barrels: three

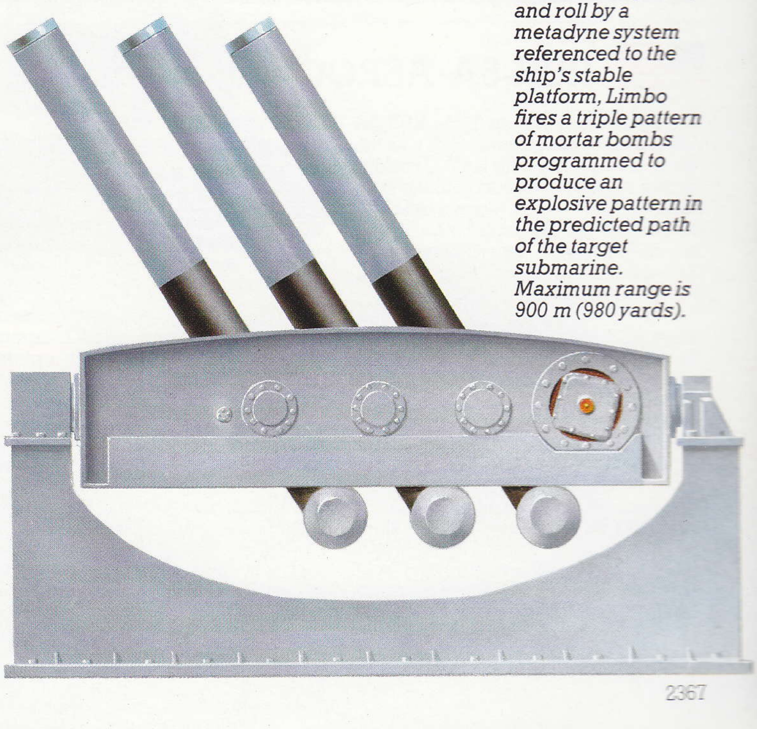
Bomb weight: 175 kg (385 lb)

Warhead: 92 kg (202.4 lb) HE

Performance: maximum depth 375 m (1,230 ft); range 0.9 km (0.56 miles)



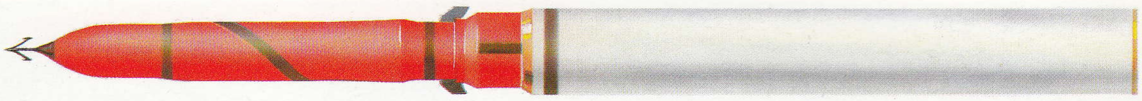
Above: Limbo has been in service with the Royal Navy for over 20 years, and is still in use despite being classified as obsolete. However, it remains a useful weapon in shallow waters that present difficulties for acoustic homing torpedoes. The Royal Australian Navy has at least updated its Limbo systems.



Stabilized in pitch and roll by a metadyne system referenced to the ship's stable platform, Limbo fires a triple pattern of mortar bombs programmed to produce an explosive pattern in the predicted path of the target submarine. Maximum range is 900 m (980 yards).

USA

UUM-44A SUBROC submarine rocket



Developed in the early 1960s, SUBROC is carried by the 'Permit' and 'Sturgeon' classes of attack submarine. Launched through a torpedo tube, its rocket motor blasts it out of the water and powers it on a flight of up to 56 km (35 miles) before it drops a 5-kiloton yield nuclear depth charge.

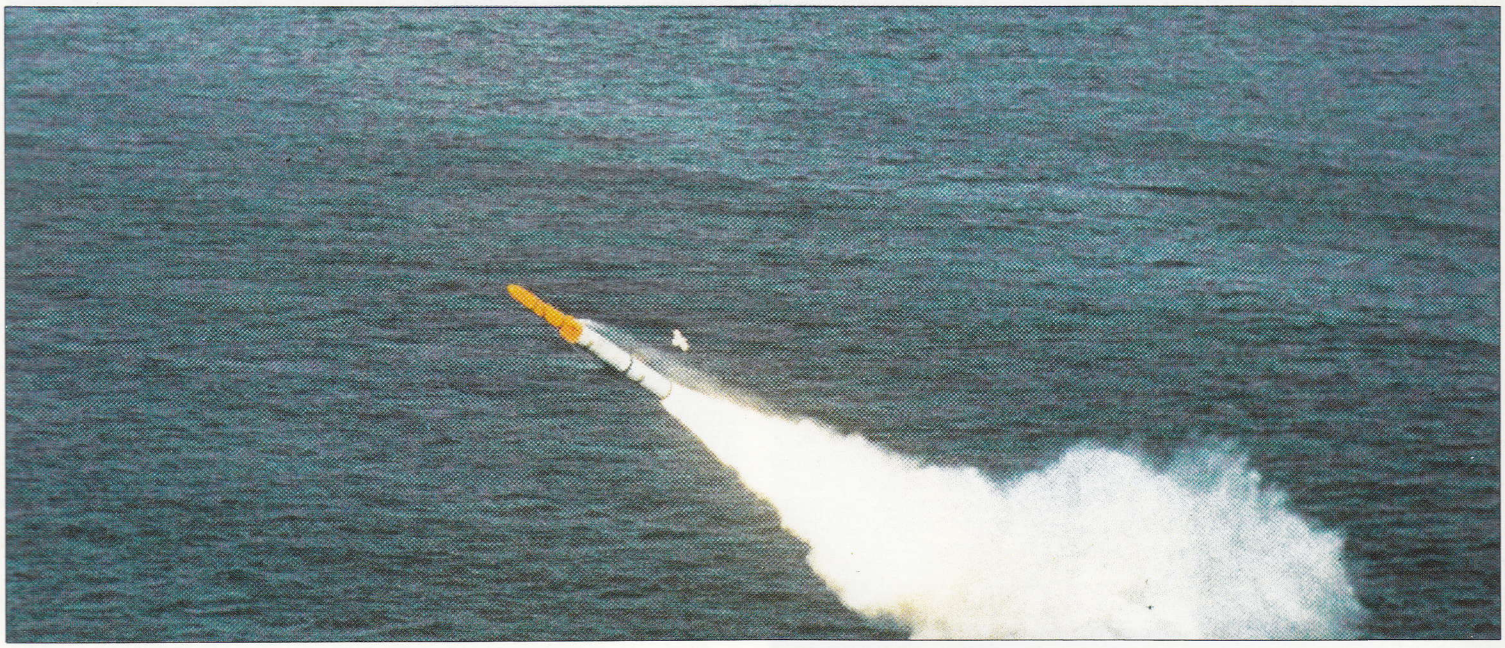
Development of the two-stage **UUM-44A SUBROC** submarine rocket began in 1958, the complete technical evaluation being finished by 1964. The first production rounds were delivered to the US Navy in the following year, and the average SSN basic load is four to six rounds. The SUBROC formed part of an advanced ASW system for its time.

Target heading and range data are determined by the submarine's onboard sonar suite. The co-ordinate data are then fed into the analogue Mk 113 fire-control system, which programmes an optimum flight profile into the missile's intertial guidance unit in terms of its course, speed and warhead separation point. The missile is then launched horizontally from the standard 533-mm (21-in) torpedo tube by normal means. At a safe distance from the submarine (and with the rocket not necessarily in the direction of the target) the solid-fuel rocket motor ignites and the weapon follows a short level path before pitching up and out of the water. In both submerged and airborne flight the SUBROC is steered by four jet deflectors. At the optimum payload-release point the 5-kiloton yield W55 warhead is released by a combination of explosive bolts and a thrust reversal deceleration system, and continues on a ballistic trajectory to the target area. Any minor course correction needed at this stage is performed by vanes on the depth bomb casing, which is cushioned to protect the arming and fusing mechanisms on impact with the water. The bomb then sinks to a preset depth, where a pressure fuse detonates it. The warhead has a lethal radius against submarines of some 4.8-6.4 km (3-4 miles) from its detonation point.

Under current planning the 'SSN594' and 'SSN637' classes will carry SUBROC until they retire, while other classes will give it up because of its incompatibility with their digital fire-control systems. The latter classes will instead ship the ASW-SOW missile. The SUBROC fusing system allows for the weapon to be used against surface ships with a shallow water burst, and also against ships and land targets with an airburst.

Specification
UUM-44A SUBROC

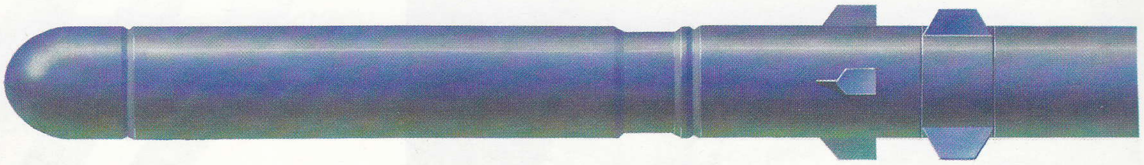
Dimensions: length 6.71 m (22 ft); diameter 0.533 m (21 in)
Weight: 1814 kg (4,000 lb)
Warhead: 294.8-kg (650-lb) 5-kiloton yield W55 fission weapon
Performance: maximum speed Mach 1.5; range 56 km (35 miles)



SUBROC exits the water at the start of its flight, its rocket motor having ignited as soon as the missile was at a safe distance from the launch submarine. Target data has been fed into its inertial guidance system, the nuclear warhead allowing considerable leeway with its 6.4-km (4-mile) lethal radius.

USA

RUR-5A ASROC anti-submarine rocket



ASROC can carry either a Honeywell Mk 46 acoustic homing torpedo or a 1.5 kiloton yield W44 warhead on a Mk 17 nuclear depth charge. It is the primary ASW system carried by US Navy destroyers, cruisers and frigates.

The all-weather day or night **RUR-5A ASROC** anti-submarine rocket was the result of combining the RAT-C rocket-thrown torpedo weapon with the concept of the rocket-thrown nuclear depth charge. The combination system called ASROC was to be a 9.1-km (5.65-mile) range ballistic rocket fired from a 12-round pepperbox launcher that was to be paired with the similar-range SQS-23 sonar. With the failure of the predecessor RAT-A the rocket had to be redesigned with a greater fin area and with launcher round capacity reduced to eight. The system entered operational service in 1962, the Mk 44 torpedo payload soon being upgraded to the more effective Mk 46 weapon. The nuclear option is the 1.5-kiloton yield W44 warhead on a Mk 17 nuclear depth charge. This option was tested as a complete system on 11 May 1962 from the destroyer USS *Agerholm* (DD826) during Operation 'Swordfish'. All target data are derived from the ship's own sonars, and are then used to predict the elevation and bearing of the launcher to ensure an optimum launch position. The rocket follows a ballistic trajectory, the solid-fuel rocket motor being jettisoned at a predetermined point. The payload then continues towards the target position. If the payload is a homing torpedo the weapon is lowered into the water by parachute, while the nuclear depth charge is allowed to hit the water and sink to a preset depth for detonation. The nuclear variant can also be used against surface ships and land targets if required. The US Navy uses both variants, and the conventional weapon is used also by Brazil, Canada, Greece, Italy, Japan, Pakistan, South Korea, Spain, Taiwan, Turkey and West Germany.

For the 1990s a longer-range vertical-launch variant known as **ASROC(VL)** is being developed with new payloads.

Specification
RUR-5A ASROC

Dimensions: length Mk 44 payload 4.57 m (15 ft) or Mk 46 payload 4.51 m (14.79 ft); wing span 0.845 m (2.77 ft); diameter 0.325 m (1.07 ft)
Weight: Mk 44 payload 434 kg (957 lb); Mk 46 payload 487 kg (1,073 lb)
Warhead: 192.8 kg (425 lb) Mk 44 or 230.4 kg (508 lb) Mk 46 Mod 1 lightweight homing torpedo, or 117.9 kg (260 lb) Mk 17 1.5-kiloton yield W44 fission weapon
Performance: maximum speed Mach 0.8; range 1.85-11.1 km (1.15-6.9 miles)

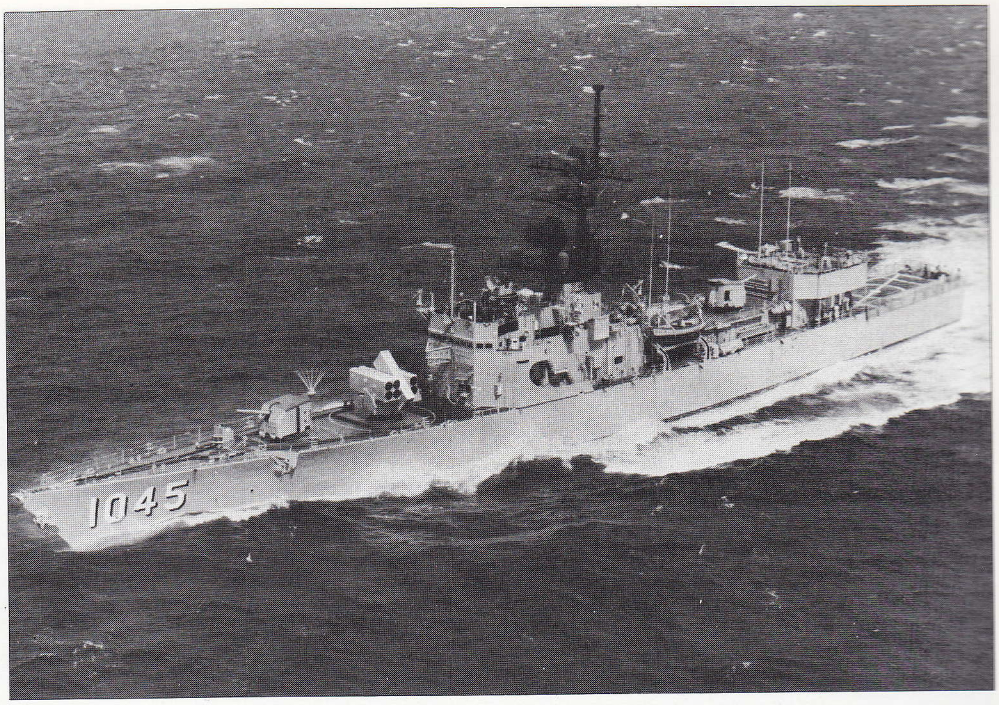
ASROC: Fleet Defender

For a quarter of a century, the primary shipborne ASW system of the US Fleet has been the weapon-carrying rocket known as ASROC. The initial thinking that led to the system dates back even further, to the last year of World War II.

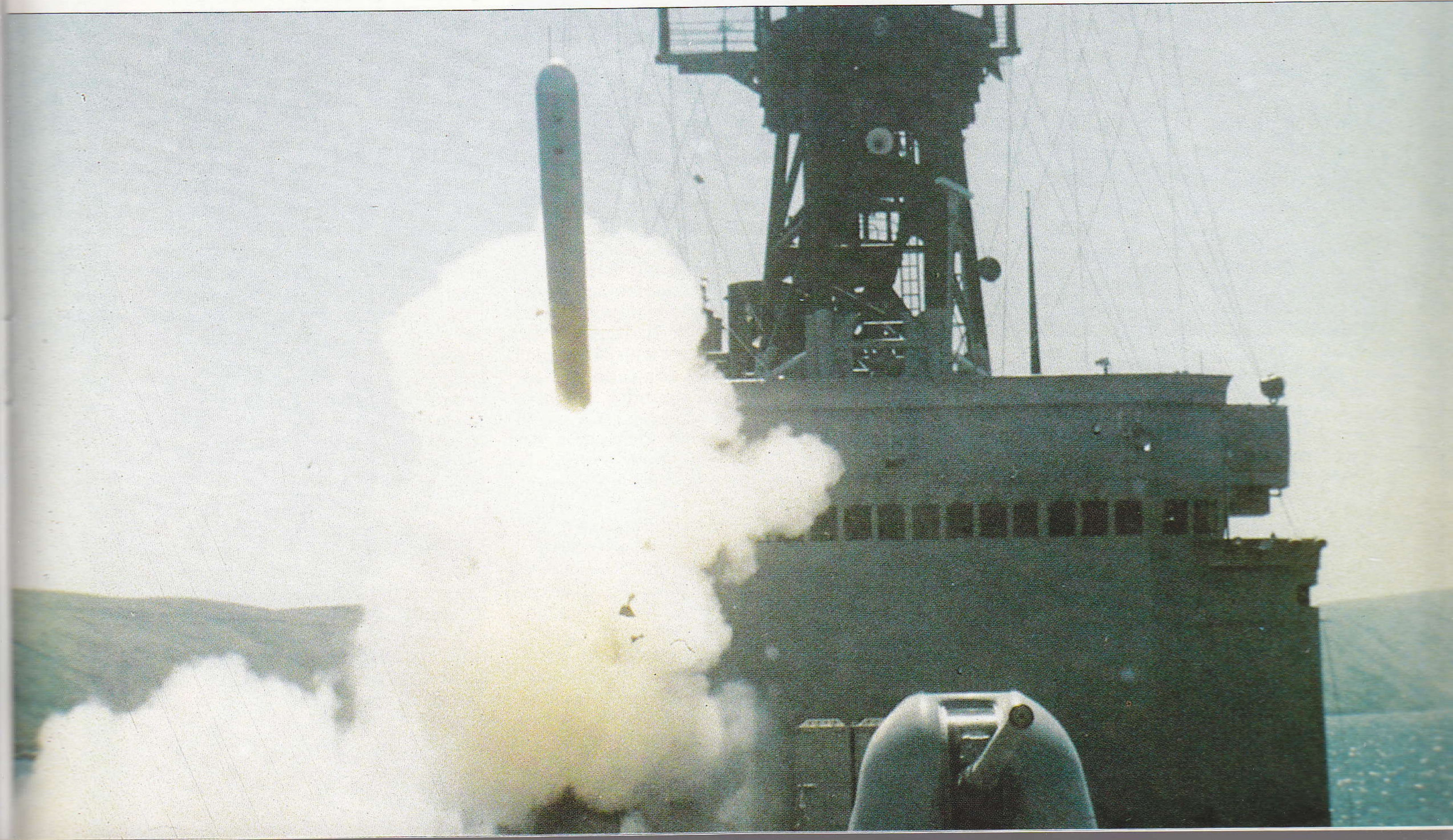
As early as 1945 the US Navy began thinking in terms of a weapon carrying a homing torpedo and designed to engage submerged targets at stand-off ranges in the order of 13.7 km (8.5 miles). Although the sonar systems then available could not possibly meet the target-detection requirements, effort was put towards developing the weapon. The initial version was designated Kingfisher E, and was a subsonic missile meant to carry a Mk 35 active/passive homing torpedo. The name soon changed to the SUM-N-2 Grebe, and the weapon was developed in two distinct versions, one a rocket-boosted short-range variant and the other a longer-range version with an additional sustainer motor. Both were to carry the Mk 41 ASW torpedo. However, the sonar problems still remained and the Grebe was subsequently cancelled in 1950.

The idea soon re-emerged when in 1951 a need was expressed for a weapon with a range in the order of 2.7 km (1.7 miles) that could supplement existing mortar type weapons. The result was the Rocket-Assisted Torpedo (RAT) programme, which was initiated in 1951 with the RAT-A, using the World War II Mk 24 torpedo. Successful tests in 1952-3 led to the proposal that the follow-on RAT-B use the new Mk 43 torpedo as the payload. The launcher could be either mounted atop a standard twin 127-mm (5-in) turret or as a simple twin-rail system in place of a twin 76-mm (3-in) mount. The design range of the RAT-B was between 1.4 and 4.6 km (0.85 and 2.84 miles) to accommodate the search capabilities of the SQS-4 sonar system. By 1956 the RAT-B system with its Mk 110 launcher and 10 reload rounds was being promoted as the replacement for the World War II Hedgehog.

In the meantime a RAT-C version had begun development to carry the 30-kt Mk 44 homing torpedo to a range of between 0.92 and 9.14 km (0.57 and 5.68 miles). By 1955 this version had been combined with a projected rocket-thrown nuclear depth charge and the new 9.14-km (5.68-mile) range SQS-23 sonar. The combination weapon was to be fired from a 12-round pepperbox launcher similar in size to a

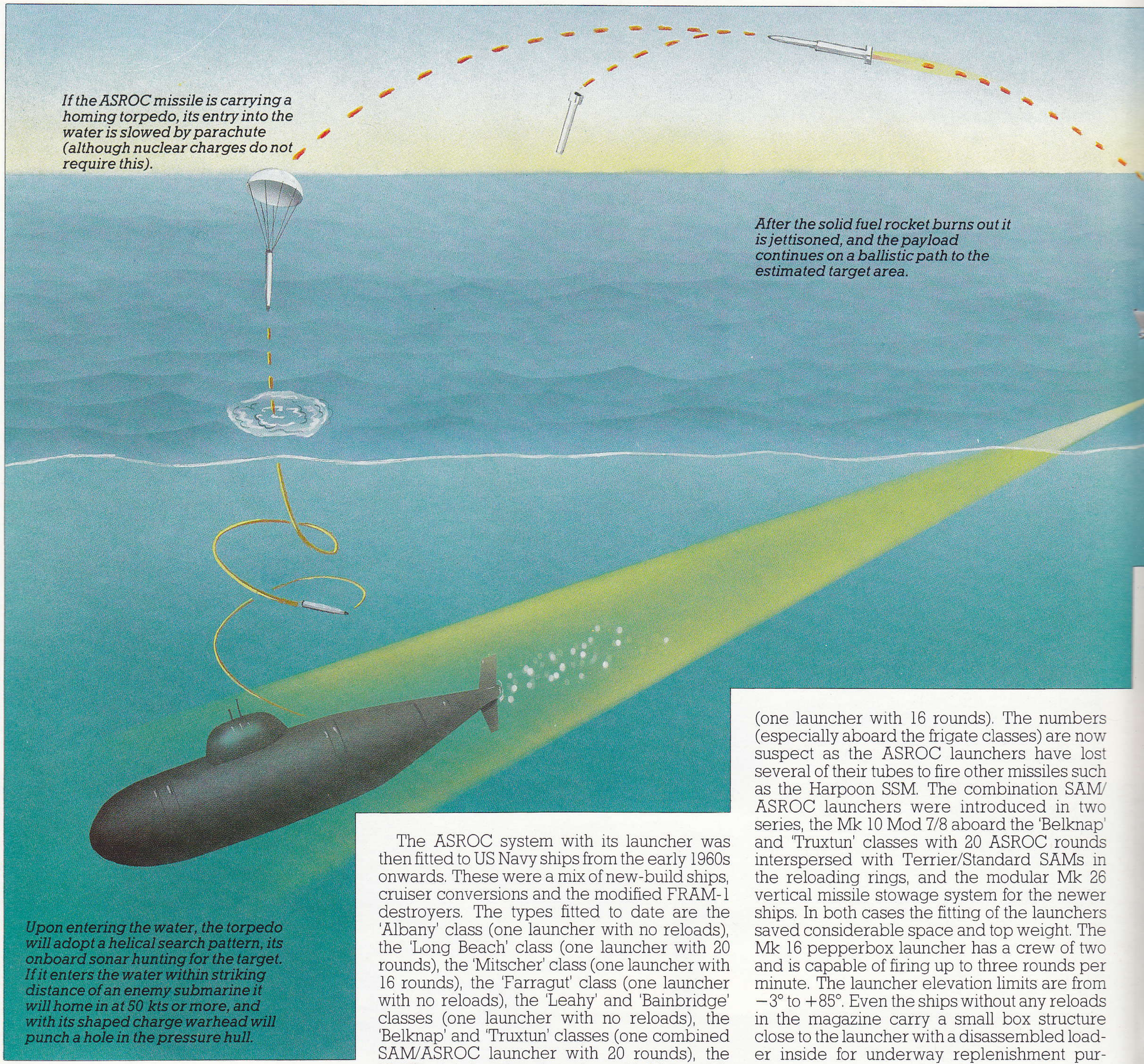


In a sense, ASROC is a successor to the wartime Hedgehog system. Naturally it has much increased capability, but the most common launching apparatus is a simple eight-round box launcher, as seen here on the 'Knox' class frigate USS Davidson *(FF 1045).*



While helicopters have become the primary shipboard offensive anti-submarine weapon, even large ASW vessels such as the 'Spruance' class retain ASROC to provide an integral ASW capacity within a radius of several kilometres around the ship.

ASROC: Fleet Defender



If the ASROC missile is carrying a homing torpedo, its entry into the water is slowed by parachute (although nuclear charges do not require this).

After the solid fuel rocket burns out it is jettisoned, and the payload continues on a ballistic path to the estimated target area.

Upon entering the water, the torpedo will adopt a helical search pattern, its onboard sonar hunting for the target. If it enters the water within striking distance of an enemy submarine it will home in at 50 kts or more, and with its shaped charge warhead will punch a hole in the pressure hull.

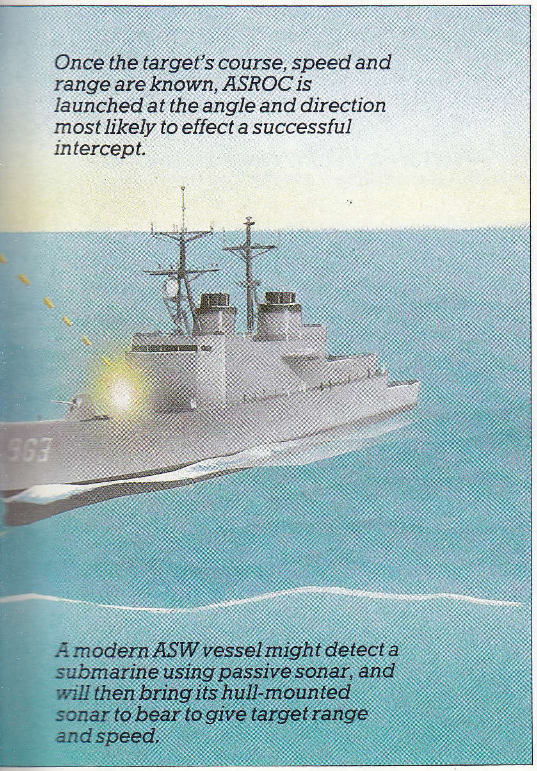
standard 127-mm twin turret.

In 1957 the RAT-B began operational evaluation aboard the destroyer USS *Sarsfield*, and although it passed some of the design requirements it was found that the rocket accuracy at long range was insufficient to place the torpedo within lethal homing distance of the target. Thus RAT-B was abandoned in favour of the RAT-C, which had by then been given the designation RUR-5A Anti-Submarine Rocket (ASROC). This had to undergo some redesign, the fin area being considerably increased and the launcher changed to carry only eight rounds. At a later date the rocket weapon was also upgraded in capabilities by the adoption of the Mk 46 torpedo as an alternative to the Mk 44.

The ASROC system with its launcher was then fitted to US Navy ships from the early 1960s onwards. These were a mix of new-build ships, cruiser conversions and the modified FRAM-1 destroyers. The types fitted to date are the 'Albany' class (one launcher with no reloads), the 'Long Beach' class (one launcher with 20 rounds), the 'Mitscher' class (one launcher with 16 rounds), the 'Farragut' class (one launcher with no reloads), the 'Leahy' and 'Bainbridge' classes (one launcher with no reloads), the 'Belknap' and 'Truxtun' classes (one combined SAM/ASROC launcher with 20 rounds), the 'California' class (one launcher with 24 rounds), the 'Virginia' class (one combined SAM/ASROC launcher with 16 rounds), the converted 'Forrest Sherman' classes (DDGs one launcher with 16 rounds, and ASW ships one launcher with 20 rounds), the 'Charles F. Adams' class (one launcher with no reloads, although several units were later fitted with a small four-round reload magazine), the 'Spruance' class (one launcher with 24 rounds), the 'Kidd' class (one combined SAM/ASROC launcher with 20 rounds), the 'Ticonderoga' class (one combined SAM/ASROC launcher with 20 rounds), FRAM-1 destroyer conversions (one launcher with 17 rounds), the 'Bronstein' class (one launcher with no reloads), some of the 'Garcia' and 'Brooke' classes (one launcher with 16 rounds), and the 'Knox' class (one launcher with 16 rounds). The numbers (especially aboard the frigate classes) are now suspect as the ASROC launchers have lost several of their tubes to fire other missiles such as the Harpoon SSM. The combination SAM/ASROC launchers were introduced in two series, the Mk 10 Mod 7/8 aboard the 'Belknap' and 'Truxtun' classes with 20 ASROC rounds interspersed with Terrier/Standard SAMs in the reloading rings, and the modular Mk 26 vertical missile stowage system for the newer ships. In both cases the fitting of the launchers saved considerable space and top weight. The Mk 16 pepperbox launcher has a crew of two and is capable of firing up to three rounds per minute. The launcher elevation limits are from −3° to +85°. Even the ships without any reloads in the magazine carry a small box structure close to the launcher with a disassembled loader inside for underway replenishment purposes.

US Navy operational doctrine appears to be to fire two torpedo-carrying ASROCs or one nuclear-armed ASROC at a submerged target. Under special circumstances the latter can also be fired against surface ships and shore targets.

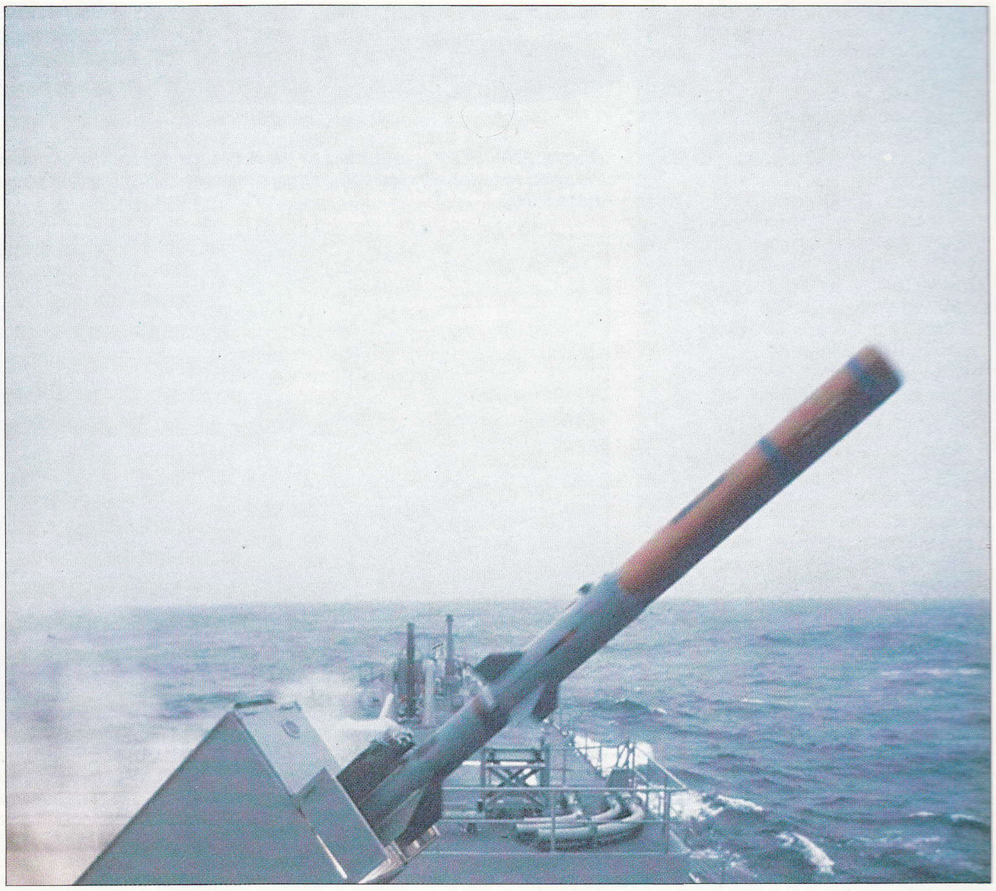
Because of the rapid development of Soviet submarine designs and the stand-off weapons they carry, the ASROC has become outdated as a result of its insufficient range capabilities. Thus by the early 1980s the Americans had initiated a new vertical-launch version to be fired from the vertical missile launchers being produced for the new generation of surface ships and for retrofitting to the most capable of the older ship classes. The payload remains a homing torpedo of either the Mk 46 Mod 5



Once the target's course, speed and range are known, ASROC is launched at the angle and direction most likely to effect a successful intercept.

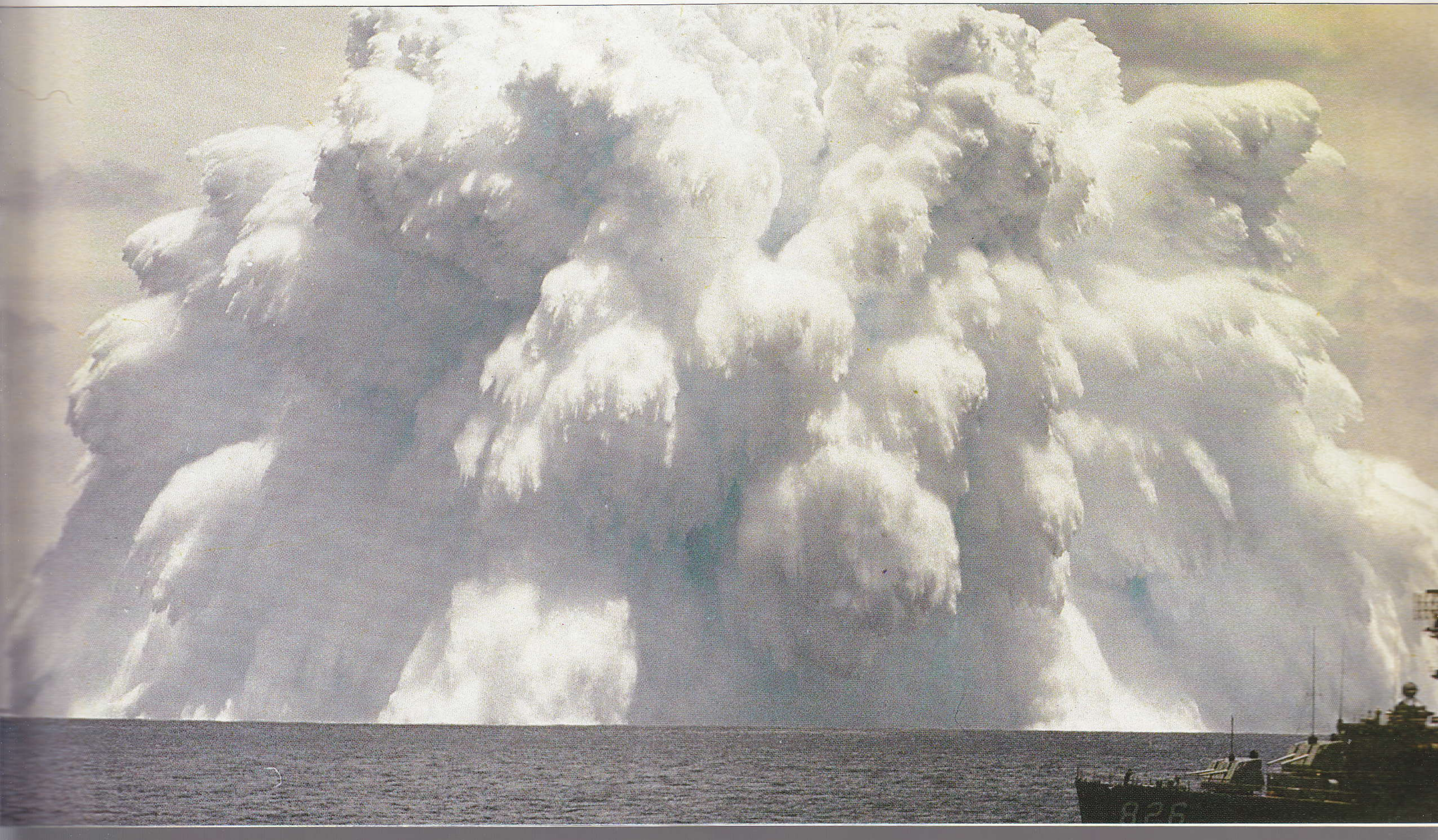
A modern ASW vessel might detect a submarine using passive sonar, and will then bring its hull-mounted sonar to bear to give target range and speed.

NEARTIP or the new Mk 50 Barracuda type. The option of a nuclear depth charge will also be there if current or future American lightweight torpedo technology cannot match that of the Soviet fourth- and fifth-generation deep-diving nuclear submarines. Even allowing for this, the older ASROC will remain around for a good many years yet in the arsenals of NATO and other friendly navies which have conventional submarines as their primary opponents.



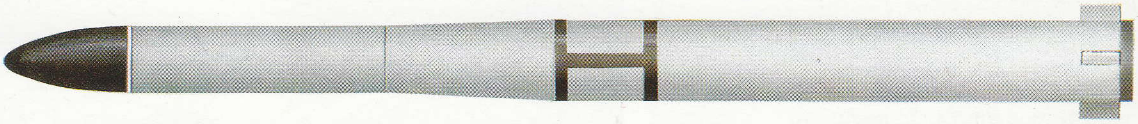
Above: In concept, ASROC is simply a ballistic rocket designed to get a homing torpedo or a nuclear depth charge into reasonable proximity of an underwater target, from where the torpedo's homing mechanism or the sheer power of a nuclear blast can ensure a kill.

Below: The power of an underwater nuclear blast is stunning. It should be realized that the mountain of water dwarfing the 3,500-ton destroyer USS Agerholm is actually several kilometres beyond the vessel. This test in May 1962 was the first live firing of nuclear ASROC.



USA

Anti-submarine warfare stand-off weapon (ASW-SOW)



Above: ASW-SOW is intended as the replacement for the obsolete SUBROC carried by US Navy attack submarines. Planned to enter service sometime in the late 1980s, the first vessels scheduled to receive it are the 'Los Angeles' class SSNs.

The **ASW-SOW** was approved in 1980 as the late-1980s long-range anti-submarine warfare system to succeed the SUBROC aboard US Navy attack submarines. Following a competitive concept phase, the team of Boeing with Gould Inc. and Hercules Aerospace was chosen to continue weapon development.

Following target designation by the digital Mk 117 fire-control system and sonars, the torpedo tube-launched missile is carried in a capsule to the surface before its single-stage solid-fuel rocket motor ignites. On clearing the surface of the sea, four small wrap-around fins at the rear of the rocket motor casing deploy automatically to stabilize the missile in flight. After booster burn-out the system is probably jettisoned, leaving the payload to follow a ballistic trajectory to the target zone, where after deceleration the warhead (either a Mk 50 Barracuda Advanced Lightweight Torpedo or a nuclear depth bomb) is released.

The ASW-SOW will be capable of engaging targets out to at least the second convergence zone, which is at least twice the range of SUBROC. Originally it was conceived that the ASW-SOW would also be surface-ship compatible, but technical and programme difficulties have resulted in a separate weapon based on an ASROC(VL). Primary platform for the ASW-SOW will be the 'Los Angeles' class SSN, although older SSNs will be retrofitted as required.

Specification

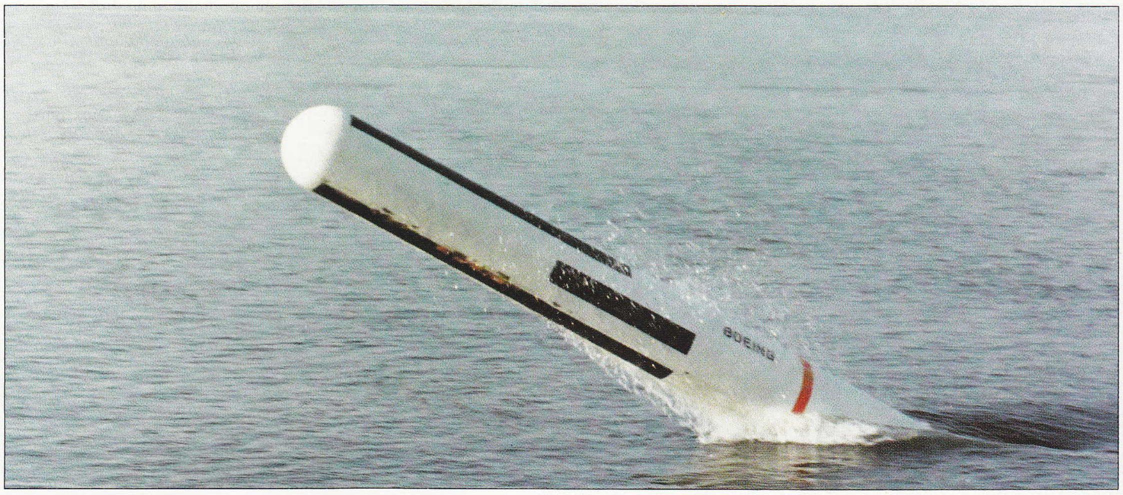
ASW-SOW

Dimensions: length 6.4 m (21 ft); diameter 0.533 m (21 in)

Weight: 1224.7 kg (2,700 lb)

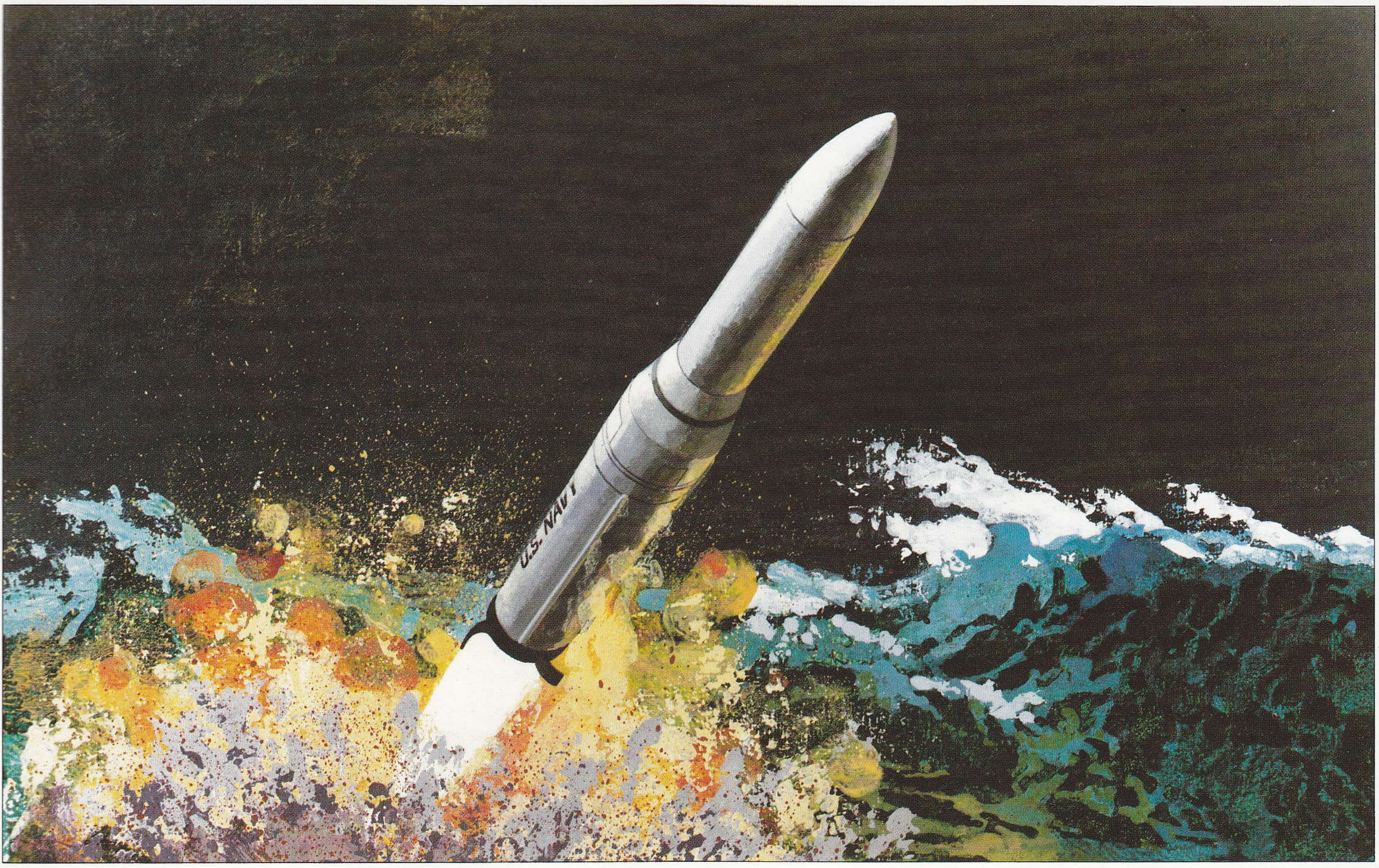
Warhead: 362.9-kg (800-lb) Mk 50 homing torpedo or nuclear depth charge

Performance: maximum speed Mach 1.5+; range 101-166.5 km (62.8-103.5 miles)



Above: An engineering model of ASW-SOW is successfully launched by Boeing in Washington's Puget Sound. The production missile will carry either a Mk 50 Barracuda Advanced Lightweight Torpedo or a nuclear depth charge. ASW-SOW will have a speed of Mach 1.5 plus.

Below: How Boeing envisage the ASW-SOW beginning its mission. After the missile exits the water, four small wrap-around fins at the rear of the rocket motor casing deploy automatically to stabilize it. A separate version is being developed for use by surface vessels.



USA

Mk 60 CAPTOR mine

The aluminium-case **Mk 60 CAPTOR** encapsulated torpedo mine is the US Navy's principal offensive anti-submarine warfare barrier weapon for use in the vicinity of deep-water routes that enemy submarines are likely to travel without escort.

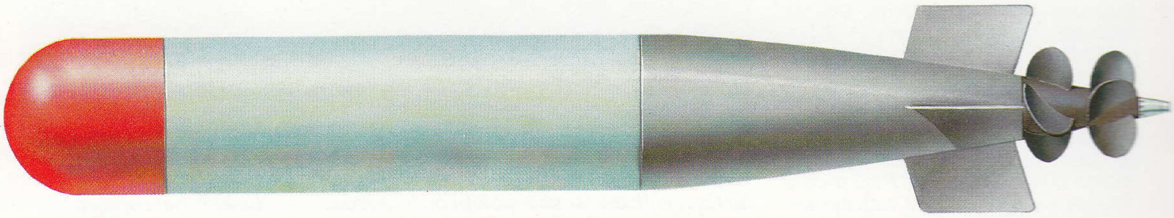
CAPTOR is fitted with a detection and control unit (DCU) that is capable of detecting and classifying submarine targets over an estimated range of 1 km (0.62 miles) but gated to ignore surface traffic. There is, however, no identification friend or foe system, so friendly submarine units must be warned of any laying or spots where CAPTORs have already been deployed. The current operational life of the mine is believed to be six months underwater before self-neutralization devices are activated. The initial target detection is carried out by a passive sonar, while the optimum release time for the Mk 4 Mod 4 homing torpedo payload (which is built with the latest Mod 5 NEARTIP improvements already implemented) is determined by a second (active) ranging set.

CAPTORS may be laid by surface ship, submarine or aircraft, the first platform requiring only an over-the-side boom or crane with a capacity of 1247 kg (2,750 lb) to ensure correct orientation of the mine when it hits the water. Any submarine with standard 533-mm (21-in) torpedo tubes can lay a CAPTOR, while aircraft deploy a parachute-equipped version. Likely wartime airborne delivery platforms include SAC Boeing B-52Hs, US Navy Lockheed P-3C Orions and possibly Lockheed C-130 Hercules transports.

After several years of problems the CAPTOR became fully operational in 1979, an improvement programme being initiated in the following year. A minimum of 2,500 CAPTORs are due to enter the US Navy's inventory by the time production ends.

Specification
CAPTOR
Dimensions: length air/surface-launched 3.68 m (12.08 ft) or submarine-launched 3.51 m (11.5 ft); diameter 0.533 m (21 in)
Weight: air/surface-launched 1184 kg (2,610 lb) or submarine-launched 1069 kg (2,356 lb)
Payload: Mk 46 Mod 4 homing torpedo
Maximum depth: 915 m (3,000 ft)

Right: CAPTOR mines can be deployed by an over-the-side boom or crane to ensure the correct orientation of the mine when it lands in the water. Submarines can launch CAPTOR through their torpedo tubes. Aircraft deploying these mines will include Boeing B-52Hs and Lockheed P-3C Orions.



The active component of CAPTOR consists of a Mk 46 Mod 4 lightweight torpedo, armed with a 43.5-kg (96-lb) shaped charge warhead designed to punch holes in pressure hulls. The ALWT (Advanced Lightweight Torpedo) currently under development may well be used in modified form in the future.

USA

Mk 67 submarine-launched mobile mine (SLMM)

The **Mk 67** SLMM dual anti-ship anti-submarine weapon is intended to provide the US navy submarine force with a capability for covert laying of ground influence mines in heavily defended and/or relatively inaccessible shallow waters. The platform used to perform the operation is a modified Mk 37 torpedo with its warhead and homing systems replaced by all the components needed to turn the weapon into a ground mine. Single and multi-influence fusing systems have been developed for this weapon and the new mines of the Quickstrike programme. At least 1,500 Mk 67s are required to meet current US Navy requirements. It is believed that a submarine will carry two Mk 67s in place of each standard 533-mm (21-in) sized weapon offloaded. At present all submarine classes up to the 'Los Angeles' class are fitted for minelaying, but it should be remembered that each submarine so loaded cannot carry many other weapons, thus effectively limiting its operational flexibility.

Specification
Mk 67 SLMM
Dimensions: length 4.09 m (13.4 ft); diameter 0.485 m (19 in)
Weight: 753 kg (1,660 lb)
Warhead: estimated 159-227 kg (350-500 lb) HE
Performance: speed 18 kts; maximum depth 100 m (330 ft); range 16.5 km (10.3 miles)

'Los Angeles' class attack submarines can carry two Mk 67 mines in place of one standard 533-mm (21-in) torpedo. The Mk 67 mine gives US submarines the ability to lay ground-influence mines in heavily defended waters.

Depth charges and bombs

The **Cardoen AS-228** depth charge is a current example of the world's longest established anti-submarine weapon, which was first used in combat by the Royal Navy in World War I. The depth charge is a relatively simple weapon which can be rolled or catapulted into the sea by a thrower or mortar. It is generally fitted with a hydrostatic (pressure-activated) fuse that in modern depth charges allows targets to be engaged at depths between 30 and 500 m (100 and 1,640 ft). In appearance the depth charge can either be of conventional cylindrical shape or (as in the case of the AS-228) a streamlined teardrop with small fins for a faster sink rate.

The charges are dropped in patterns that are calculated to cover a volume notionally centred on the target in order to maximize the probability of its destruction. To improve lethality further the standard fuse on some charges can be replaced either with a magnetic- or acoustic-activated influence type, which gives virtually unlimited depth capability.

Surprisingly, in most Western navies the depth charge has gone out of favour except in its air-dropped variants for aircraft and helicopters. A typical example of this type is the British **Mk 11** series which has its origins in World War II. Fitted with a tail section that breaks off on impact with the water, the main body has an explosive charge armed by a hydropneumatic fusing system. These conventional air-dropped charges are complemented by nuclear models designed and built in the USA. These are used by the aerial ASW forces of the USA, UK, West Germany and the Netherlands. The weapon used is the 5/10-kiloton yield **B57** tactical gravity bomb fitted with a depth pressure fuse. The Royal Navy also apparently uses an indigenously designed and built 1-kiloton yield ASW version of its **Green Parrot** variable-yield bomb.

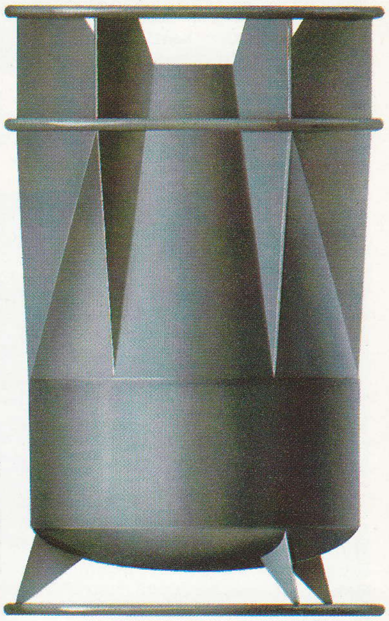
Depth charges of the classic World War II sort have largely gone out of fashion, with the notable exception of those arming the ASW helicopters which are in the front line of modern ASW effort. Aircraft such as the SH-3 Sea King of the US Navy are even capable of carrying nuclear weapons.

Specification

US Mk 16 Mod 0 (hydrostatic) and Mk 16 Mod 1 (acoustic) depth charges
Weight: 197.3 kg (435 lb)
Maximum depth: 762 m (2,500 ft); the Mod 1 has no limit

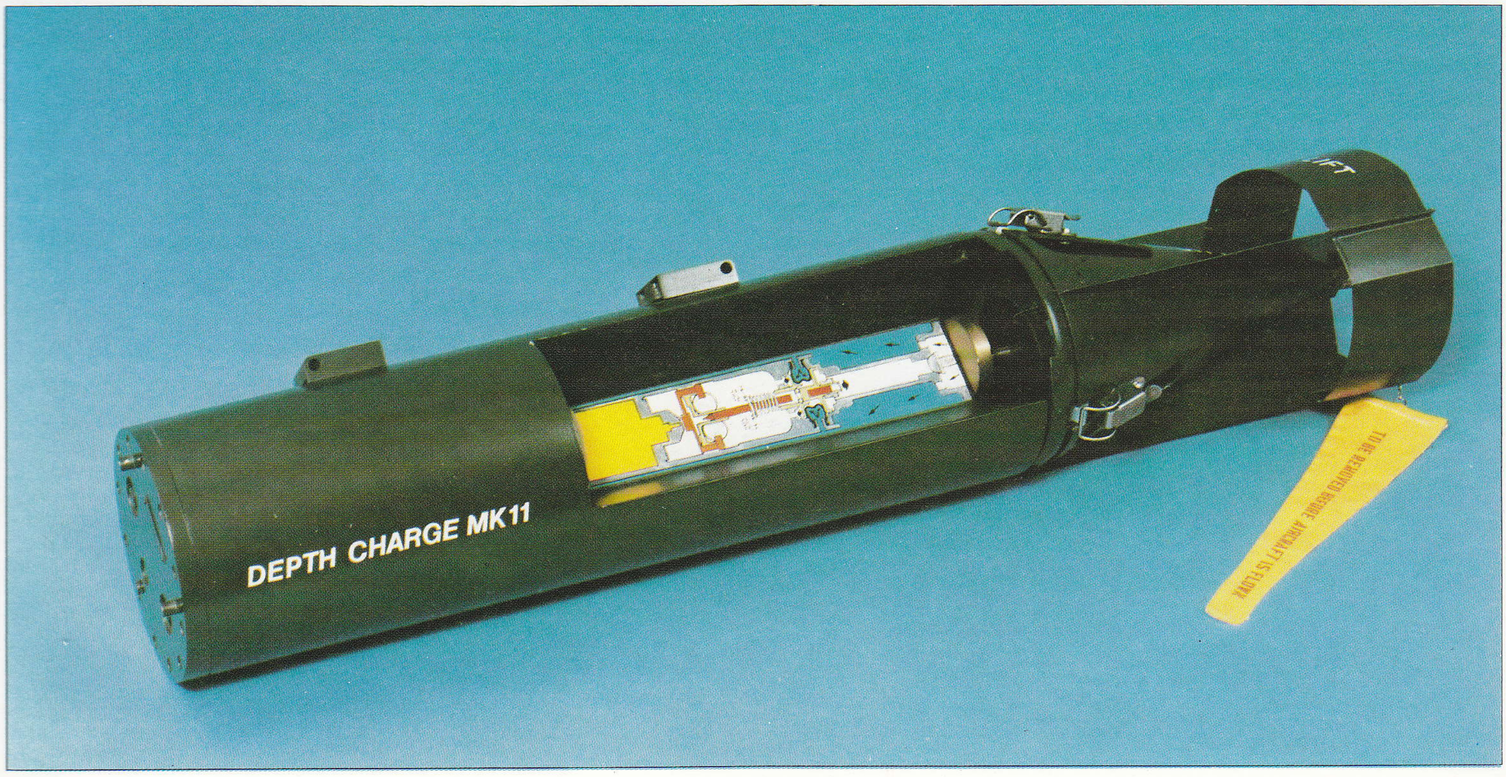
British Mk 11 Mod 3 air-dropped depth charge
Dimensions: length 1.40 m (4.6 ft); diameter 0.28 m (0.92 ft)
Weight: 144.7 kg (319 lb)
Warhead: 80 kg (176 lb) HE
Maximum depth: 90 m (295 ft)

US B57 Mod 1 air-dropped nuclear depth bomb
Dimensions: length 3.0 m (9.8 ft); diameter 0.374 m (1.23 ft)
Weight: 347 kg (765 lb)
Warhead: 5/10-kiloton yield W57 fission weapon
Maximum depth: about 1000 m (3,280 ft)



Cardoen's AS-228 depth charge is one of the last of the general purpose depth charges in the old style to be manufactured, and is launchable from surface ships and from the air. Most navies now reserve the depth charge as a helicopter weapon (except the very special case of the nuclear charge).

The sectioned model of British Aerospace's air-launched Mk 11 depth charge displays many of the features common to such weapons. The tail fins break off on impact with the water, allowing hydropneumatic arming. The Mk 11 is designed specifically for deployment from helicopters and MR aircraft.



To Kill a Sub

Since the early years of this century the submarine has been one of the few weapon systems that could truly be called 'strategic'. Its ability to choke the seaborne commerce of a nation, and more recently inflict nuclear destruction upon whole populations in a fashion undreamed-of only 30 years ago, has made the techniques to seek it out and destroy it absolutely vital.

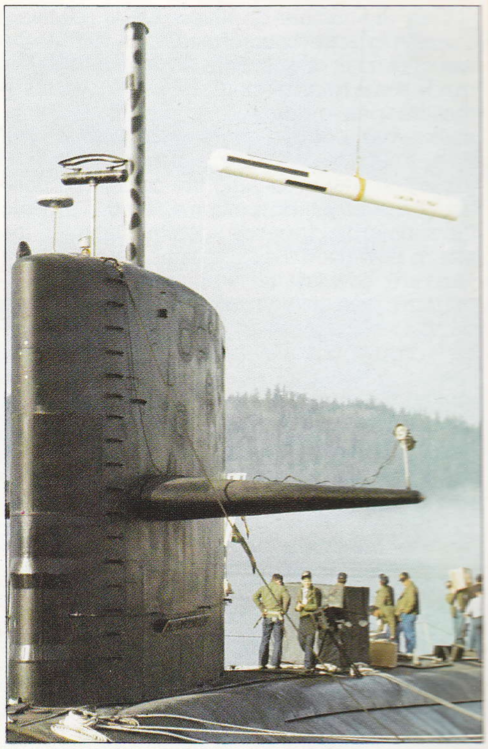
The destruction of a submarine is the final act in a series of actions. Taken in logical sequence these are the detection, classification and localization of the target, and then its destruction. The first is usually achieved by some type of acoustic sensor (such as a sonar or sonobuoy), or by ESM or by radar depending on what systems the hunter is carrying. Once a target is detected it must first be confirmed as a genuine submarine contact (the classification phase) and then its position accurately fixed by the platform's sensors (the localization phase) in order for the attack to be carried out with a weapon appropriate for the environment.

Nuclear charge

By far the easiest way to ensure the destruction of the target is to use a nuclear depth charge or bomb. However, although such a weapon has a wide lethal radius, its use prevents further acoustic sensor operations over a wide area. This condition lasts for a significant period as a result of the underwater sound reverberations caused by the explosion. At the other extreme is the use of patterns of ship- or air-launched conventional depth charges or similar weapons. These require precise placing on and around the target in order for their contact or proximity fusing systems to be successfully triggered.

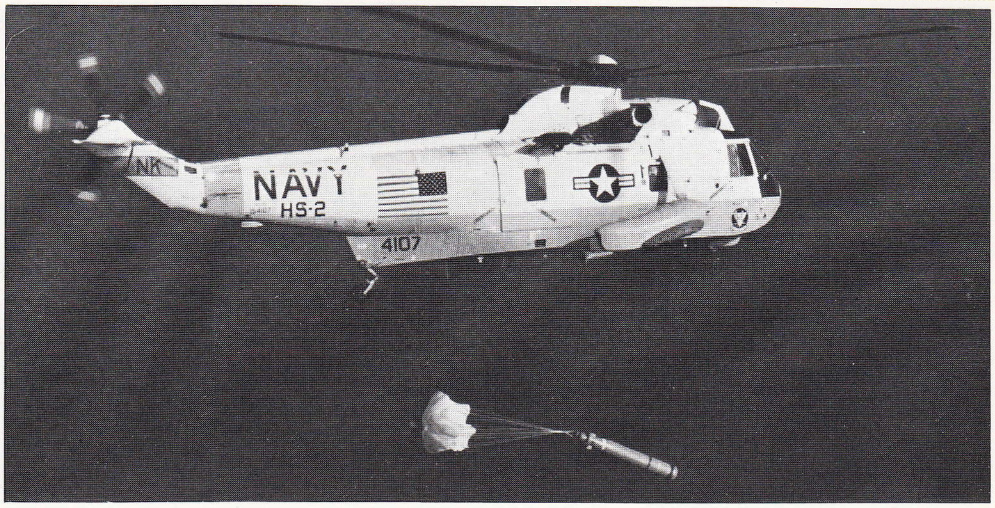
Nowadays such weapons also require surface ships fitted with such systems to come to within an unacceptably close distance of the target's own defensive weapons. In order to overcome these difficulties and to match the performance of later sonars, the lightweight homing torpedo was developed. This has generally replaced the mortar and depth charge thrower in most navies, and in theory matches the area nuclear weapon in terms of its engagement envelope, but still needing either direct contact or very close proximity to the target for detonation purposes. The Soviet use of double-hull submarine designs has resulted in the original blast type warheads of older torpedoes (such as the Mk 44 and the Mk 46) being replaced on new weapons (such as the Stingray and Mk 50 Barracuda) by a shaped-charge type which essentially punches a small hole in the metal. At the depths at which most nuclear submarines are found, water pressure does the rest. To extend the engagement range of such torpedoes farther, it has proved possible to add either a rocket motor or winged missile casings. The US Navy led the way with its ASROC and SUBROC systems for its torpedoes and nuclear depth charges, while the Soviets followed later with what were initially its own 'Sovietized' variants of the two (the FRAS-1 and the SS-N-15 probably based on stolen plans) and then with the SS-N-14 winged missile and the SS-N-16 torpedo-carrying submarine-launched missile.

In all cases the vehicles used to transport the torpedo or depth charge to the vicinity of the target uses a guidance system and some type of weapon-release unit. Once in the water the torpedo carries out a preprogrammed search pattern, while the depth charge simply sinks to a predetermined depth before exploding.



For the future, undoubtedly the most advanced anti-submarine system will be the American ASW-SOW system, with significant improvements in guidance and double the range of ASROC.

The best hunter of submarines is often another submarine, armed with a high-speed, heavyweight torpedo. Here a Mk 24 'Tigerfish' wire-guided torpedo is being loaded into a 'Churchill' class nuclear fleet submarine of the Royal Navy.



The combination of the lightweight, high-speed torpedo allied to the ASW-dedicated helicopter (often with its own detection equipment) has widened the area of action of the modern warship to a tremendous extent. The ocean has not been conquered, however, and nature can often play havoc with the most advanced of man's inventions.

Only the nuclear depth charge is relatively immune to target countermeasures, such as the use of decoys or anechoic hull coatings to degrade sonar transmissions. However, whatever the weapon employed against it, the submarine has a period of grace called the 'blind time'. This is the period during which the ASW projectile is approaching the calculated position of the target. How much safety this gives to the submarine depends upon the nature of the attack, how good the submarine detection systems are, how fast the submarine can run submerged, its manoeuvrability, and the maximum depth to which it can dive. For instance a Soviet navy 'Alpha' class nuclear attack submarine can easily defeat all but a nuclear depth charge attack, diving extremely deep below the operational depth of most lightweight torpedoes and by performing evasive manoeuvres at speeds above those possible by most Western surface ships and submarines. This is not even taking into consideration the use of mobile decoys or the submarine's anechoic coating. In the case of the Mk 46, the sonar acquisition range is reduced by some 30 per cent against such a coating, although the latest Mod 5 NEARTIP version is designed to overcome this problem and restore the guidance system's original parameters. Obviously this is an extreme scenario as most submarines in the Soviet navy are less capable than the 'Alphas'.

For use against Soviet submarines, the primary weapon of Western submarines is the heavyweight torpedo. This uses wire-guided homing units to direct the torpedo into the vicinity of the target, where its own active/passive sonars take over for the terminal attack phase. Once in contact or very close proximity to the target a heavy blast-type warhead explodes to damage or destroy the hull. The initial wire guidance relies on the use of the submarine's own sonar systems to provide target position data for the torpedo controller.

For the future the possibility of putting a towed sonar array on a torpedo is being explored. This will provide a more accurate localization system than currently provided aboard most platforms, as well as making the weapon even more independent than before. The final version could very well be an intelligent torpedo fitted with IFF logic circuits, dormant action circuits and a linear array. The Americans would appear to be some way along this road with their Mk 60 CAPTOR mine, which sits in deep water waiting for a target to come within range of its sensors so that it can fire the onboard Mk 64 Mod 4 torpedo. It may be possible even at some stage to modify the new Mk 67 SLMM with new technology so that it can be fired at slow speed into the vicinity of a Soviet submarine base, where it sinks to the bottom and lies dormant until a passive sonar indication of a target brings it to life again. A linear sonar array could then be deployed as the torpedo gets underway to home the weapon into a position where an active ranging sonar can direct the terminal attack phase at high speed.

The final line of defence against the submarine on almost 250 major vessels of western navies is provided by ASROC, seen here launched from a 'Brooke' class frigate of the US Navy.

USSR

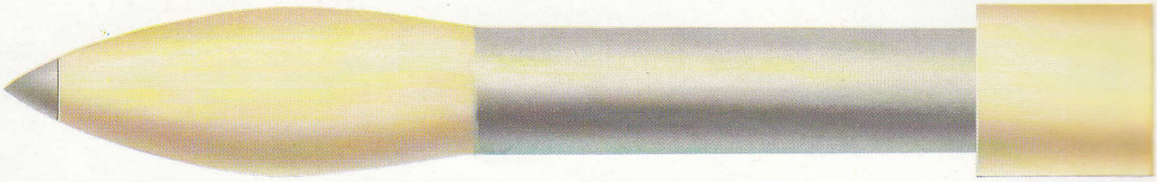
RBU anti-submarine rocket-launchers

Over the years the USSR has developed a number of multi-barrel rocket-launchers under the designation Raketnaya Bombometnaya Ustaovka (RBU), and these use the ahead-firing 'hedgehog' principle. The rockets are immune to torpedo countermeasures, and under certain circumstances can actually be used as anti-torpedo weapons if there is enough warning. All the rockets are fitted with either contact or magnetic influence fuses. The most widely used version is the fully automatic 250-mm (9.84-in) **RBU6000**, which entered service in 1962. The 12-barrel launcher is arranged in a horseshoe shape with automatic fuse setting systems, and the rockets are fired in a paired sequence. The HR projectile weighs 70 kg (154 lb) overall, and loading is accomplished barrel by barrel with the launcher in the vertical position.

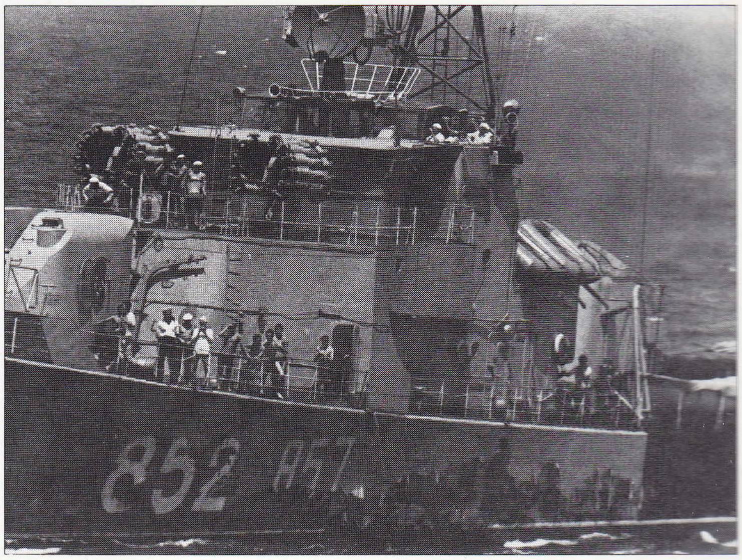
The RBU6o0 is usually fitted in conjunction with the fully automatic six-barrel 300-mm (11.81-in) **RBU1000** of the same date, but which uses a larger rocket with a 55-kg (121-lb) warhead.

Earlier systems of the RBU series include the 1957-vintage automatic 250-mm 16-barrel **RBU2500** with manual reloading; the 1958-vintage five-barrel 250-mm **RBU1200** with manual reloading, automatic elevation but manual training; and the 1960-vintage six-barrel manually reloaded **RBU600**. Most systems have three to five complete sets of reload rounds in the ship's magazines, while the rocket types are common to each calibre except that the RBU1200 fires an earlier type of rocket with a 34-kg (75-lb) HE warhead.

Practically all the Warsaw Pact navies use one or more RBU systems, and Soviet client states also use them widely. The People's Republic of China has taken some of the earlier designs and produced its own variants.



The 250-mm calibre rocket used in the various Soviet multiple launcher systems has a warhead weighing up to 34 kg (75 lb). These are not guided systems, the rockets being fired in patterns to bracket a target.



Above: A Soviet 'Petya' class patrol vessel, on station in one of the Soviet navy's now regular forays into the waters around the Philippines, displays her twin 12-barrelled RBU 6000 rocket launchers, as well as the desire of Soviet sailors to get in as much sunbathing as possible.

Specification
RBU series

weapon	calibre	range	barrel length	weights	
				rocket	warhead
RBU6000	250 mm (9.84 in)	6 km (3.73 miles)	1.6 m (5.25 ft)	70 kg (154 lb)	21 kg (46.3 lb)
RBU2500	250 mm (9.84 in)	2.5 km (1.55 miles)	1.6 m (5.25 ft)	70 kg (154 lb)	21 kg (46.3 lb)
RBU1200	250 mm (9.84 in)	1.2 km (0.75 miles)	1.4 m (4.6 ft)	70 kg (154 lb)	34 kg (75 lb)
RBU1000	300 mm (11.81 in)	1 km (0.62 miles)	1.5 m (5 ft)	120 kg (265 lb)	55 kg (121 lb)
RBU600	300 mm (11.81 in)	0.6 km (0.37 miles)	1.5 m (5 ft)	120 kg (265 lb)	55 kg (121 lb)

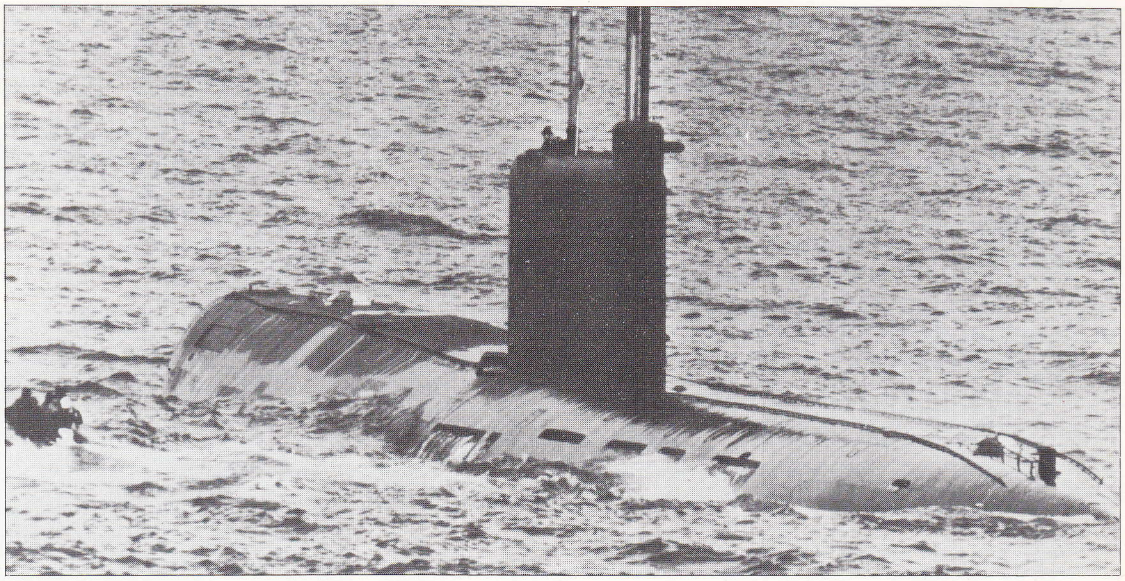
Below: Soviet 'Krivak' class frigates have a considerable anti-submarine potential. Among the weapon systems carried are two of the ubiquitous 12-barrel RBU 6000 ASW rocket launchers, mounted ahead of the main bridge structure.

USSR

ASW rising mines and CAPTOR type mines

One of the most effective ASW weapons that the Soviets have in their inventory is the offensive rising mine. The weapon is designed primarily for use against submerged targets in areas adjacent to NATO submarine bases, at choke-points and on nuclear submarine deep-water transit routes. Of the two types so far identified, one is for use on the continental shelf (NATO reporting name **'Cluster Bay'**) and the other for use on the deeper continental ledge region (NATO reporting name **'Cluster Gulf'**). Both are tethered torpedo-shaped devices fitted with solid-fuel rocket propulsion units. Initial target detection is by passive sonar, precise target location then being fixed by transmissions from a second active sonar. If the target is confirmed as being within the vertical attack zone the tether is cut and the rocket motor ignited. The high upward speed allows the target very little time for evasion even if it detects the launch. Both mines can be used in an anti-ship role if required.

Since deploying the rising mine the Soviets are believed to have developed a mine similar in concept to the American CAPTOR, but with a 450-mm (17.7-in) acoustic-homing torpedo as the payload. Also primarily targeted against submarines, the mine allows strategic ASW mine barriers to be laid across choke-points in order to funnel NATO submarines into waiting surface and sub-surface ASW hunter-killer groups. Laid offensively in mixed fields with rising mines, some of the homing torpedo payloads could be specificially tuned to attack the NATO deep-water mine-countermeasures vessels tasked with sweeping them. Primary delivery platforms for all three types are submarines, while barriers can be sown by surface ships and aircraft, the latter being ideally suited for renewing a field and as a fast reaction force.



Unlike the US Navy, the Soviet Union has a large force of conventionally powered submarines. These boats, such as this 'Tango' seen off the British Isles, would undoubtedly use their inherent quietness in laying mines at strategic points.

Specification

rising mine
Type: moored acoustic influence
Laying depth: 600 m (1,970 ft)
Warhead: 225 kg (496 lb) HE
Weight: 1200 kg (2,646 lb)

CAPTOR type mine
Type: moored acoustic torpedo carrier
Laying depth: 750 m (2,460 ft)
Payload: 450-mm (17.7-in) acoustic-homing torpedo
Weight: 1500 kg (3,307 lb)

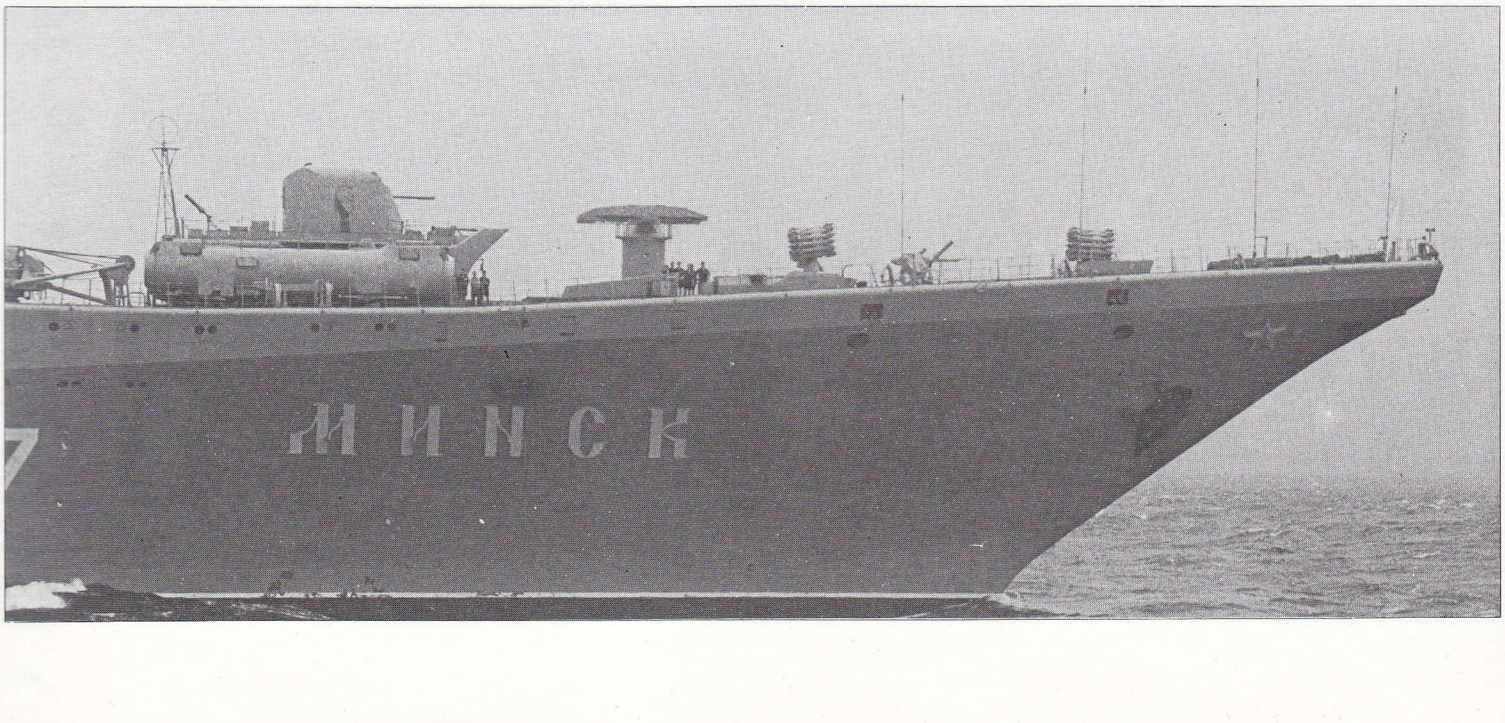
USSR

FRAS-1 anti-submarine warfare rocket

The **FRAS-1** (Free Rocket Anti-Submarine) is an unguided single-stage solid-fuel ballistic weapon which was developed from the Soviet army's FROG artillery rocket series, and entered service in 1967. Target range and bearing data are obtained by the launch platform's own long-range low-frequency sonar sets. These data are then used to calculate the target's predicted course so that the launcher can be aimed to give the optimum rocket trajectory. The uncertainty of placing the rocket within a conventional weapon kill zone is considerably reduced by the use of a 15-kiloton yield pressure-fused nuclear depth charge as the payload. Recent information indicates that there is now a variant of the rocket fitted with a 450-mm (17.7-in) acoustic-homing torpedo as the payload for use in conventional conflicts. The launcher is designated the SUW-N-1 by NATO, and is similar in design to the surface-to-air launchers of the SA-N-1/3 series with twin rails. Only two classes are fitted with the system: the two 'Moskva' class helicopter cruisers and the four 'Kiev' class aircraft-carriers. In each case the system comprises one SUW-N-1 launcher on the forward end of the ship with a below-decks magazine of 20 rounds.

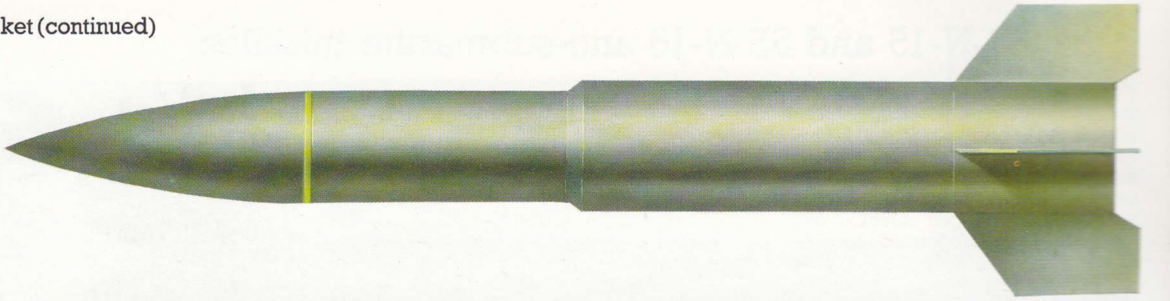
Specification (provisional)

FRAS-1
Dimensions: length 6.2 m (20.3 ft); wing span 1.3 m (4.3 ft); diameter 0.7 m (2.29 ft)
Weight: 800 kg (1,764 lb)
Warhead: 15-kiloton yield fission weapon or 450-mm (17.7-in) acoustic-homing torpedo
Performance: maximum speed Mach 1+; range 30 km (18.6 miles)



The bow view of the 'Kiev' class carrier Minsk *operating in the East China Sea displays both the RBU 6000 launchers and the twin launcher for the much larger FRAS-1 rockets. The missiles are launched on ballistic trajectories towards the target position (calculated from the target's course and speed).*

FRAS-1 anti-submarine warfare rocket (continued)

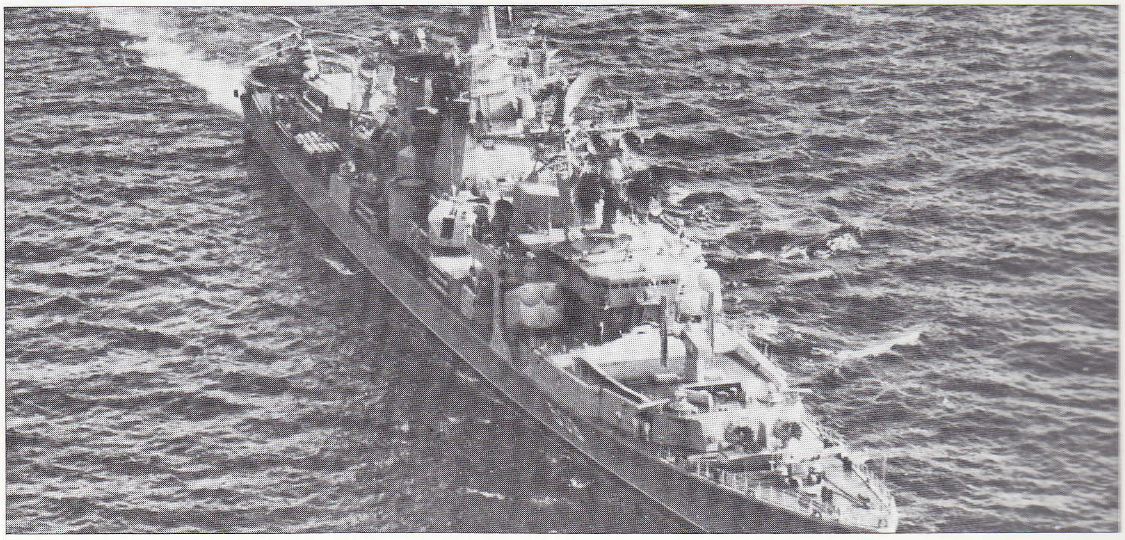


The FRAS-1 (Free Rocket Anti-Submarine) is reputedly based upon the Soviet army's unguided FROG missile. The 30-km (18.6-mile) range and lack of guidance implies no great accuracy, but with a 15-kiloton nuclear warhead accuracy is not strictly essential.

USSR

SS-N-14 anti-submarine missile

The **SS-N-14 'Silex'** conceptually resembles the Australian Ikara and French Malafon in that a subsonic winged vehicle carrying a homing torpedo is guided to the promiximity of a submerged target, whereupon the parachute-retarded payload is released into the water to make the final attack. In a brilliant piece of deception the Soviets managed to make NATO believe that this missile was in fact a tactical SSM. As part of this plan the first warships equipped with 'Silex' launchers went to sea in 1968, although the missile itself was not carried until 1974. The SS-N-14 also has a secondary anti-ship role. Carried in quadruple launchers of two distinct types, the 'Silex' forms the main ASW armament of the 'Kara', 'Kresta II' and 'Udaloy' class large ASW ships, and of the 'Krivak I' and 'Krivak II' series missile patrol ships. The guided missile cruiser *Kirov* also has on its forecastle a twin launcher which is reloadable from a 16-round magazine below decks. The large ASW vessels carry eight rounds, while the patrol boats only have four. The torpedo carried is believed to be of the 450-mm (17.7-in) acoustic-homing type with a 100 kg (220 lb) HE warhead. A variant with a nuclear depth bomb is also likely, with a yield of 2.5 kilotons. Guidance on the 'Kara' and 'Kresta II' classes is effected by the SA-N-3 'Headlight' fire-control radars, while on the other platforms it is a dedicated 'Eye Bowl' radar director. Up to two missiles at a time can be guided. The minimum engagement range for any target type is said to be 7.4 km (4.6 miles).



The quadruple SS-N-14 missile launchers on either side of the bridge of a 'Kara' class cruiser are an indication of the size of Soviet shipborne systems.

Specification

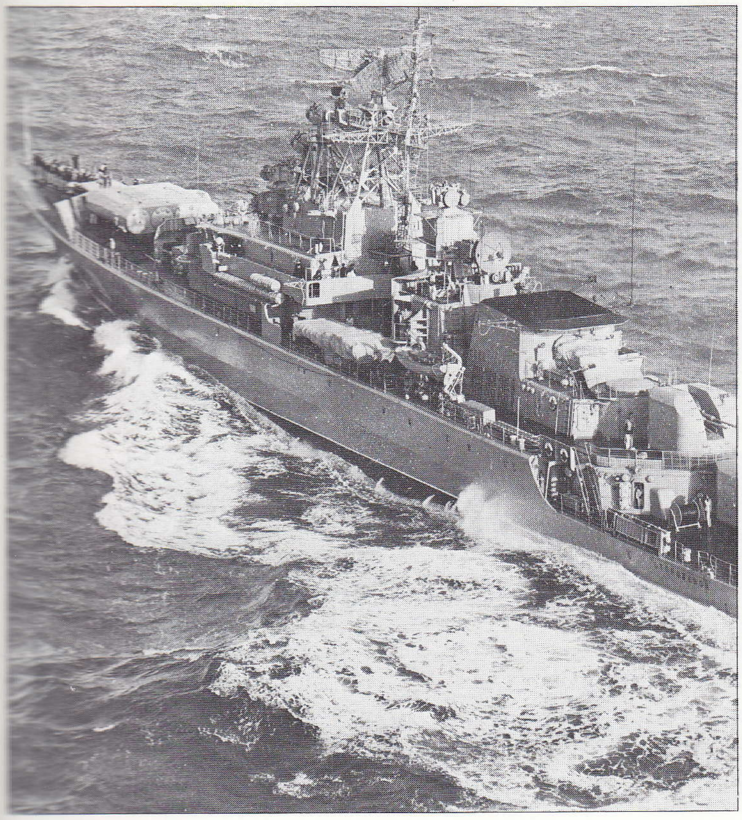
SS-N-14

Dimensions: length 7.6 m (24.9 ft); wing span 1.1 m (3.6 ft); diameter 0.55 m (1.8 ft)

Weight: 1000 kg (2,205 lb)

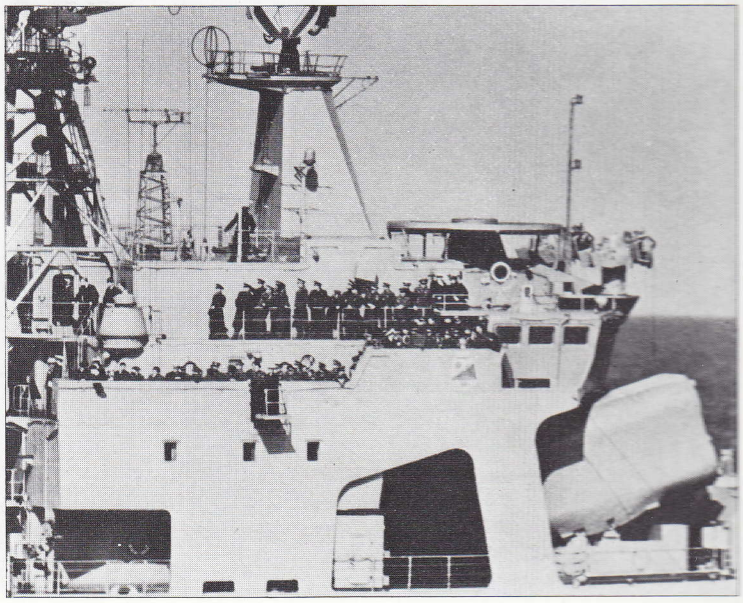
Payload: 450-mm (17.7-in) acoustic-homing torpedo

Performance: speed Mach 0.95; range 55 km (34.2 miles)



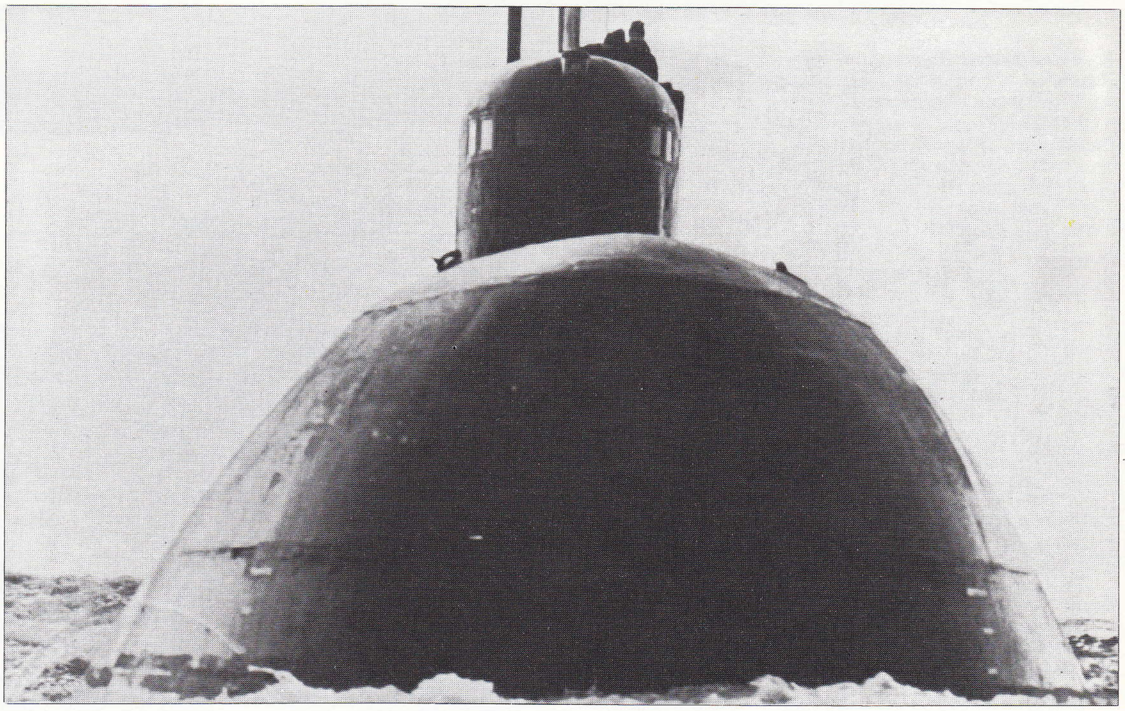
Left: The plethora of weapon and sensor systems common to all Soviet warships is dominated on this 'Krivak' class frigate (seen in the English Channel) by the massive quadruple bow launcher for four SS-N-14 missiles. The weapon is believed to be similar to the Malafon and Ikara systems.

Below: A close-up of the bridge and starboard quadruple missile launcher of the large anti-submarine dedicated destroyer Udaloy *also shows one of the 'Eye Bowl' fire control radars associated with the SS-N-14 system (visible atop the bridge immediately above the massive missile containers).*



USSR

SS-N-15 and SS-N-16 anti-submarine missiles



The **SS-N-15** submarine-launched anti-submarine missile entered operational service in 1972, and is believed to have been developed from technology gained by the GRU military intelligence service during operations against the American SUBROC system. Fired from standard 533-mm (21-in) torpedo tubes, the inertially guided solid-fuel rocket-powered SS-N-15 follows a short underwater path before broaching the surface to fly an airborne trajectory to the predicted target zone. On reaching this a nuclear depth bomb of 15-kiloton yield is released to continue on a ballistic course until it enters the water. The bomb then sinks to a preset depth, where its pressure fuse detonates the warhead. Soviet submarine types known to have been fitted with the missile system are the nuclear-powered 'Victor I', 'Victor II', 'Victor III', 'Sierra', 'Alpha', 'Akula', 'Mike', 'Charlie I', 'Charlie II', 'Papa' and 'Oscar' classes, plus the conventionally powered 'Tango' class.

In the mid-1970s a development of the SS-N-15 appeared in the form of the larger-calibre and longer-ranged inertially guided solid-fuel rocket-powered **SS-N-16**, which carries an acoustic-homing ASW torpedo as its payload in lieu of a nuclear depth bomb. Fired like the SS-N-15, it differs in that over the target area a parachute is used to lower the weapon to the water, where its protective nose cap is released. Once it has sunk to a preset depth the torpedo starts a programmed series of search manoeuvres, a terminal attack manoeuvre being used to engage any target encountered. Submarines fitted with this missile are believed to include the 'Victor II', 'Victor III', 'Sierra', 'Charlie II', 'Oscar', 'Mike' and 'Akula' classes. Both missile types have secondary anti-ship roles.

Specification

SS-N-15

Dimensions: length 6.5 m (21.3 ft); diameter 0.533 m (21 in)

Weight: 1900 kg (4,189 lb)

Warhead: 15-kiloton yield fission weapon

Performance: maximum speed Mach 1.5; range 37 km (23 miles)

SS-N-16

Dimensions: length 6.5 m (21.3 ft); diameter 0.618 m (24.3 in)

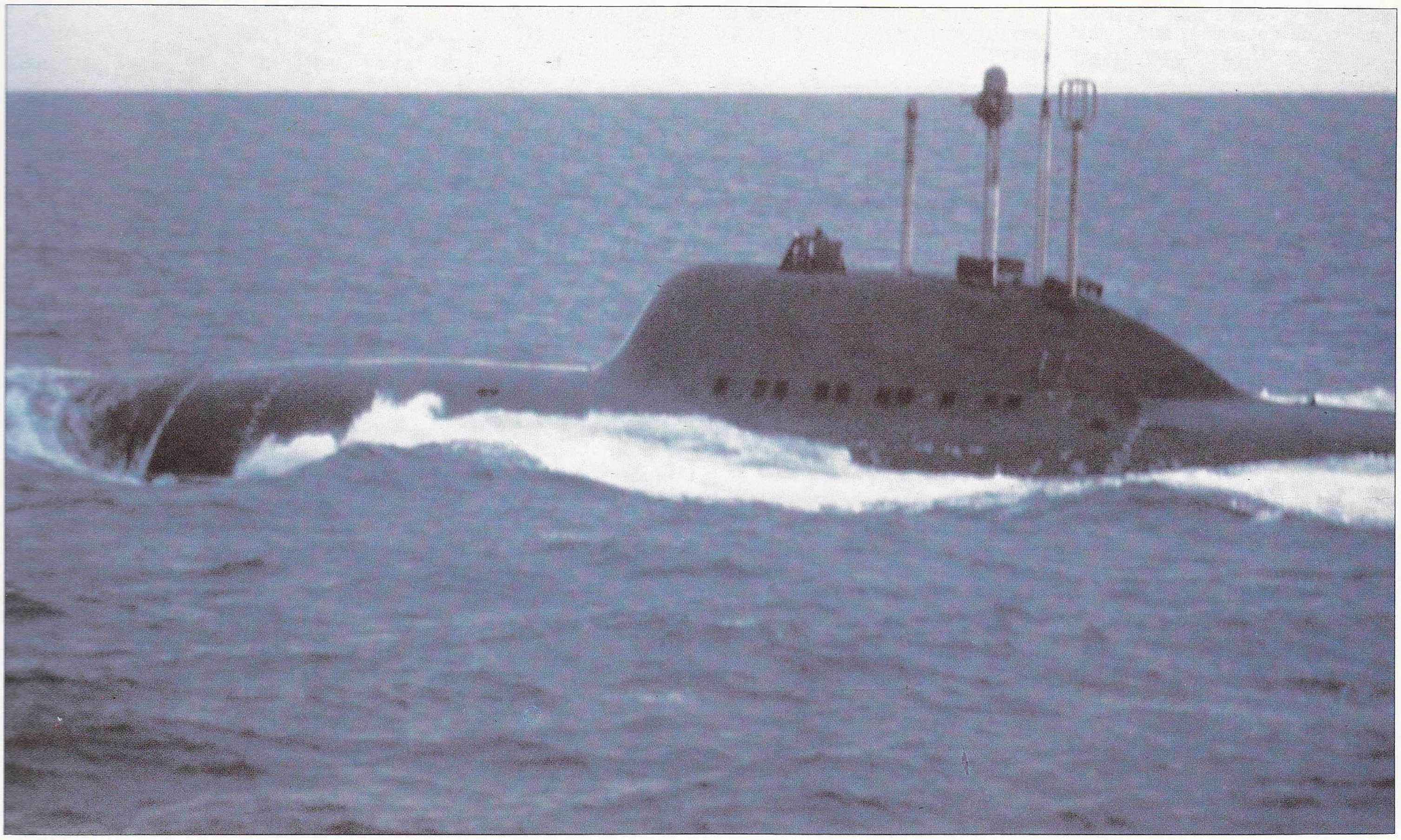
Weight: 2150 kg (4,740 lb)

Warhead: 450-mm (17.7-in) acoustic-homing torpedo

Performance: maximum speed Mach 1.5; range 55 km (34.2 miles)

Believed to have been built from plans stolen from the US Navy, the SS-N-15 is fitted to Soviet nuclear boats as well as diesel-powered 'Tango' class vessels, seen here.

The 'Alpha' class, the fastest (and probably the most expensive) boats in the world, are known to have been fitted with the SS-N-15 SUBROC copy.



Spain

The Army

Now a member of NATO, Spain is in the final throes of constitutional change after 40 years of personal dictatorship by General Franco. The changes have included a major shake-up of the armed forces, which is to culminate in a reorganization of the military regions and by the end of 1985 in a 45,000-man reduction in the army manpower level to 195,000. The army is divided into two sections: the Immediate Intervention Force (Fuerza de Intervencion Immediata, or FII, organized for mobile operations anywhere in Spain or its overseas possessions) and the Territorial Defence Force (Fuerza de Defensa Operativa del Territorio, or FDOT, for the defence of the military regions in which they are stationed); and there is an aviation element.

The composition of these formations is as follows:

FII

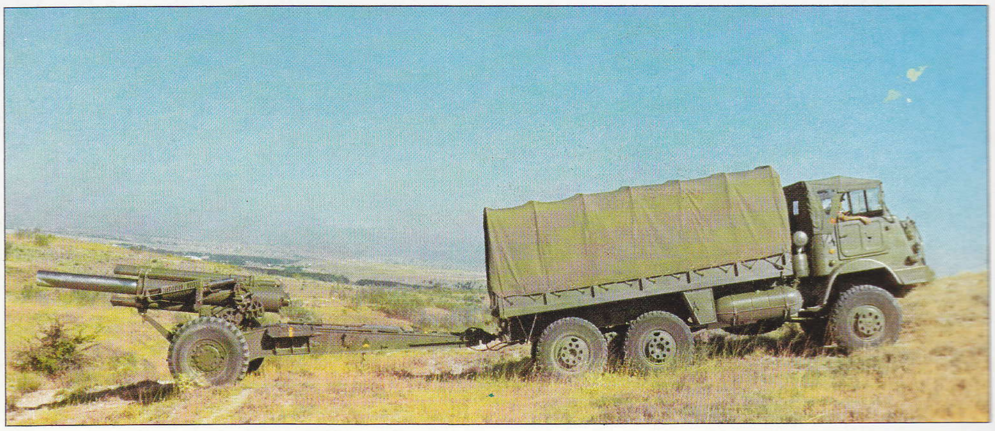
one corps headquarters,
one armoured division (with two armoured brigades and a further brigade in cadre),
one mechanized division (with one mechanized and one motorized brigade and a further motorized brigade in cadre),
one motorized division (with two motorized brigades and a further brigade in cadre, to be upgraded to a mechanized division),
one armoured cavalry brigade (of three regiments),
one parachute brigade (of three battalions),
one airportable brigade (of two infantry battalions with a third in cadre),
one infantry brigade (reserve)
one heavy artillery brigade,
one multiple rocket-launcher regiment,
one air-defence regiment,
one artillery-locating regiment,
one engineer regiment,
one signals regiment, and
one NBC defence regiment.

(The FII can also call upon the independent Royal Guards Regiment.)

FDOT

two mountain divisions (each with a mountain brigade of three mountain infantry battalions and a mountain engineer battalion and a second mountain brigade in cadre; one motorized infantry battalion; one artillery règiment; one parachute company; one engineer battalion and one aviation battalion),
one high mountain (or Alpine) brigade;
nine infantry brigades (each with three infantry battalions, an artillery battalion, a reconnaissance company, an engineer company and a signals company; these brigades are being reorganized),
four Foreign Legion (Tercio) regiments (each of two battalions),
one artillery brigade (including SAM elements),
two heavy artillery regiments,
one coastal artillery brigade (of two regiments),
five independent coastal artillery regiments,
one anti-tank infantry regiment,
one engineer regiment,
two railway engineer regiments, and
one signals regiment.

The infantry equipment is on the whole designed and produced indigenously, while most of the heavy weapons and armour are imported from the USA or France. However, there is a growing heavy arms industry which has licence-built the French AMX-30 MBT in recent years, and which has also designed and built the current BLR and BMR series of armoured vehicles. For the future there is the Lince MBT programme, which will be a locally-built version of a modern MBT for the late 1980s.



Despite the pace of social change following the death of General Franco, the Spanish armed forces have remained loyal to King Juan Carlos. Most heavy weapons like this 105-mm howitzer are imported from the USA but soft vehicles like this Pegaso truck are locally produced.

The basic weapon types used by the Spanish army are listed below.

armour: AMX-30, M47E, M47E1, M47E2 and M48A5E MBTs, M41 light tank, AML-60 and 90 armoured cars, VEC armoured scout car, BMR-600 IFV, BLR APC and M113 APC;
artillery: (self-propelled) 105-mm M108, 155-mm (6.1-in) M109/M109A1/M109A2, 155-mm M44, 175-mm (6.89-in) M107 and 203-mm (8-in) M110; (towed) 105-mm Model 56 pack howitzer, 105-mm m/26 howitzer, 155-mm M114 howitzer and 203-mm M115 howitzer; (MRLs) 140-mm (5.5-in) Teruel, 216-mm (8.5-in) L21/E2/E3 and 300-mm (11.8-in) L-10/D3; (coastal) 88-mm (3.46-in), 152-mm (6-in), 203-mm (8-in), 305-mm (12-in) and 381-mm (15-in) guns; (mortars) various Esperanza 60-, 81- and 120-mm (2.36-, 3.18- and 4.72-in) models, 81-mm M125A1/M125A2 and 120-mm M125A1 self-propelled mortars;
anti-air: 12.7-mm (0.5-in) M55, 20-mm Rh202, 20-mm GAI-BO1, 35-mm (1.37-in) GDF-002, 40-mm (1.57-in) Bofors L/70 and 90-mm (3.54-in) M117 guns, and Nike Hercules, Improved HAWK and AMX-30 Roland SAMs;
anti-armour: 88.9-mm (3.5-in) M65 rocket-launchers, 106-mm (4.17-in) M40 recoilless rifles, and Milan, Cobra, TOW, Dragon and HOT ATGWs;
small arms: 7.62-mm (0.3-in) CETME automatic rifle and 7.62-mm 42/58 machine-guns; and
aviation: Bell UH-1B/UH-1H, Aérospatiale Alouette III, MBB BO 105, Agusta-Bell AB.206A, Agusta-Bell AB.212, Bell OH-58A and Boeing-Vertol CH-47D helicopters.

In addition to the FDOT, there are also two overseas commands for the Balearic and Canary Islands, plus the garrisons at Ceuta and Melilla in North Africa. The last has two regiments of Regulares (North African) troops plus three of the Tercio regiments, while the fourth Tercio regiment is deployed in the Canaries with three additional infantry regiments and support troops. The Balearics have only three infantry regiments with support troops as they are nearer to Spain.

The arrival of many German gun designers after World War II gave a great boost to Spanish small-arms production. These CETME assault rifles were developed by the Mauser team and were one of the first rifles to be able to fire a full power round from an unlocked breech.

McDonnell Douglas F-4C Phantoms make up two of the six interceptor squadrons assigned to Air Combat Command (MACOM). A modernization programme is now under way and Spain has recently ordered 72 McDonnell Douglas F/A-18A Hornets from the USA.

The Navy

These foreign outposts are supported by a strong navy of 57,000 men divided into nine commands including a marine force and naval air arm. The marines comprise 12,000 men divided into a marine landing regiment (for intervention purposes) and five garrison regiments located mainly in the islands.

The naval air arm provides all the aircraft for use on the carrier and surface warships, plus some of the airlift capability for the marines. In a major upgrading 12 McDonnell Douglas AV-8B Bravo V/STOL fighters have been ordered, together with six Sikorsky SH-60B Sea Hawk ASW helicopters for delivery later in the decade.

A continuing programme of licence-built surface ship and submarine production is turning the Spanish navy into a well-balanced force able to defend the Spanish coast, Spain's dependencies and various NATO sea routes.

The navy currently comprises the following units: one ASW carrier (*Dedalo* to be replaced in 1986 by *Principe de Asturias*), 11 destroyers (one 'de Lauria', five ex-'Gearing' and five ex-'Fletcher'), 14 frigates (five 'Baleares', six 'Descubierta' plus three 'FFG-7' building), 8 submarines (four 'Agosta' and four 'Daphne'), four corvettes, 30 large patrol craft, 64 coastal and inshore patrol craft, 12 coastal and ocean minesweepers, two attack transports, one LSD, three LSTs, seven LCTs, two LCUs and 20 LCMs.

The naval air arm consists of one attack, one communications and five helicopter squadrons with BAe AV-8A Matador V/STOL fighters, and Agusta-Bell AB.212, Hughes 369, Sikorsky SH-3D Sea King and Bell 47G helicopters, plus Piper Comanche and Cessna Citation fixed-wing transports.

The Air Force

To provide air defence for the country and support for the army and navy, the Spanish air force has a number of commands. The main one is the Air Combat Command (MACOM) which is tied in with the air-defence radar network and has three wings of two squadrons each. The wings each fly a single type of aircraft, namely the McDonnell Douglas F-4C and RF-4C Phantom, Dassault-Breguet Mirage IIIEE and Dassault-Breguet Mirage F.1CE fighters. For the army and maritime strike support the Tactical Command (MATAC) has two wings: these comprise two ground-attack/tactical reconnaissance squadrons with locally-built Northrop F-5A and RF-5A fighter-bombers, a reconnaissance squadron of the indigenous Hispano HA-220 Saetta light strike aircraft, a maritime patrol/ASW squadron of Lockheed P-3B Orions and a light observation/liaison flight with Cessna O-1E Bird Dogs and Dornier Do 27s and Do 28s.

The Canary Islands are covered by a separate air command which has a single air-defence/ground-attack squadron of Mirage F.1CEs, a SAR squadron with Fokker F.27 maritime MR aircraft and helicopters, and a fixed-wing transport squadron.

To support the operational commands and the army in the field, there is the Transport Command (MATRA) which has three wings of five squadrons flying the Lockheed C-130H Hercules, CASA C-212 Aviocar, de Havilland Canada DHC-4 Caribou, Dornier Do 27 and CASA 207 Azor fixed-wing transports, together with six Lockheed KC-130H Hercules tanker aircraft for inflight-refuelling.

All aircrew training is undertaken by the Training Command (MAPER) which has two fast-jet operational conversion units with Northrop F-5A single-seat and F-5B two-seater fighters, 14 training squadrons with single- and multi-engine primary and basic piston-engined trainers, plus a jet component of Lockheed T-33A and CASA C-101 basic and advanced trainers. The helicopter training syllabus is undertaken by two squadrons flying Agusta-Bell AB.47, Agusta-Bell AB.205, Hughes 300C and Bell UH-1H models.

For the specialist transport, SAR and VIP roles the air force HQ(ACGA) has two SAR, two transport, three support, one utility and one training squadrons that between them fly over 15 different types of aircraft and helicopters.

There is a modernization programme to replace the older combat aircraft types with an order recently placed for 72 McDonnell Douglas F/A-18 A Hornet multi-role fighters. The maritime patrol force is also to be upgraded by the acquisition of two modern Lockheed P-3C Orions plus additional quantities of the CASA C-212 SAR variant.

The para-military and internal security role in Spain is undertaken by the 63,500 strong Civil Guard (Guardia Civil), which is divided into infantry regiments and specialist units. It is equipped with BLR IFVs and light helicopters of the BO 105 and MBB/Kawasaki BK 117 types. The Civil Guard is backed by the 47,000-man Armed Police (Policia Armada) which is divided into infantry battalions, cavalry squadrons and troops, civil security groups and a special operations commando group. These act as the government's riot police in urban disturbances. Coastal monitoring and customs work is performed by the Maritime Surveillance Force with over 50 armed patrol boats.

CASA is one of Europe's oldest aviation companies. Recently involved in collaborative ventures like the A300 Airbus, it also produced Northrop F-5s under licence for the Spanish air force. The C-101 Aviojets seen here in training colours were produced with assistance from Northrop and MBB.